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OBSERVATIONS OF THE TOTAL SOLAR ECLIPSE OF MAY 9, 1929, MADE BY THE RUBEL ECLIPSE EXPEDITION OF SWARTHMORE COLLEGE.

By JOHN A. MILLER and ROSS W. MARRIOTT.

It was not known definitely until about the middle of November, 1928, that an eclipse expedition would be sent out from the Sproul Observatory to observe the total solar eclipse of May 9, 1929.

When it was decided that an expedition should go, there were two problems that demanded our immediate attention. The first was to select a suitable site for making observations, and the other to assemble, crate and ship the observing instruments.

The path of totality started near the southern extremity of Africa, traveled northeastward over the Indian Ocean, and crossed Northern Sumatra, Malaya, and the Philippine Islands. The path extended from about 35° east to 150° east longitude.

The weather conditions determined from the data at hand seemed on the whole somewhat better in the Philippine Islands than elsewhere along the track of the eclipse. On the other hand the time of duration of totality in the Philippines was considerably shorter, and the altitude of the eclipsed sun was much less than in either Sumatra or the Federated Malay States. Owing to the type of some of the observations planned by the expedition, the longer period of duration of totality and the higher altitude of the sun at eclipse time seemed to us to outweigh the slightly better weather conditions in the Philippine Islands. Then too, there were already a number of eclipse expeditions planning to observe in the Philippine Islands, among which was the American Expedition from the Naval Observatory.

We had yet to decide between Sumatra and the Federated Malay States. Two British expeditions were going to Malaya. As far as our weather data showed there was little if any difference in weather conditions of the two places. We had had experience in Sumatra in 1926, and remembering the courtesy and help that had been given us at that time by the Dutch Government and the people of the Dutch East Indies we decided to go to Northern Sumatra.

The final choice of the observing site in Sumatra was deferred until we arrived there. After consulting several persons, including Dutchmen and Americans who had lived in this part of Sumatra for many years, we concluded that the weather at Takengon would be more whimsical than that at Idi. On the other hand, if it were clear on eclipse day

at Takengon, its altitude of 3600 feet and a totality lasting 4 minutes 58 seconds was a combination infrequent in the experience of an eclipse observer. We chose Takengon.

Our instruments were sent from Swarthmore the day after Christmas and were shipped without charge to us direct from New York to Belawan Deli, Sumatra, on the Dutch Steamship *Saparoea,* December 30, 1928.

The observing party consisted of Prof. John A. Miller, the Director of the expedition; Prof. R. W. Marriott of Swarthmore; Prof. H. D. Curtis of Allegheny Observatory; Mrs. Miller and Mrs. Marriott of Swarthmore; Mr. J. H. Dugan of Norristown, Pa.; Mr. Walter H.

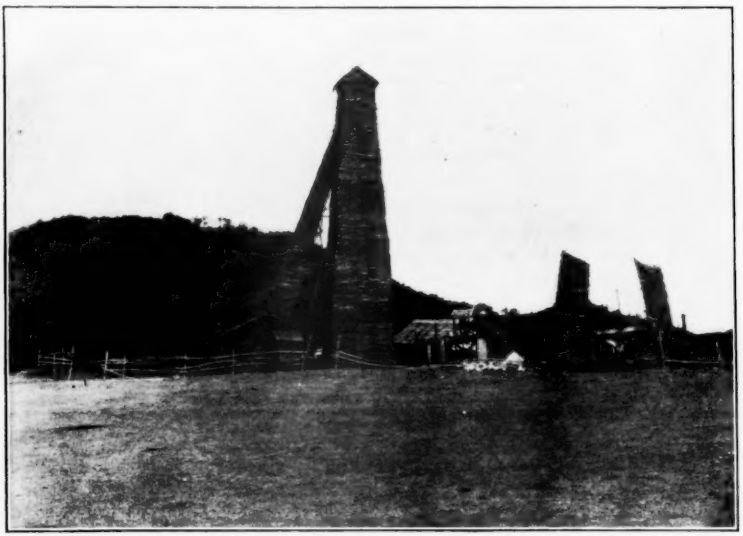


FIGURE 1.
SWARTHMORE COLEGE ECLIPSE CAMP, SHOWING TOWER TELESCOPE CAMERA IN FOREGROUND.

Robinson of Swarthmore College; Larry B. Miller of New York and Alice Elizabeth, the ten-year-old daughter of Prof. and Mrs. Marriott. Prof. and Mrs. Miller, Prof. Curtis, Messrs. Dugan, Robinson, and Miller sailed from New York January 19, 1929. Prof. Marriott and his family sailed from San Francisco three weeks later.

All members of the observing party disembarked at the little seaport of Belawan Deli, situated on the Northeast Coast of Sumatra, and then went overland by auto bus a distance of about 60 kilometers to Medan, the metropolis of Sumatra, and one of the principal cities of the Dutch East Indies. Medan is a modern city in a great many respects, and it was from here that we obtained much of our material and supplies for

erecting the eclipse instruments.

Our headquarters while in Medan was at the Hotel De Boer. Medan is about 475 kilometers from Takengon, the site which had been selected for making the eclipse observations. It required two days to make the trip from Medan to Takengon. It was very hot and tiresome, but interesting. The route was not far from the northeastern coast line and consequently at about sea level. The first three or four hours of the journey was made by a steam train via the Deli Railway. These trains are exceedingly small as compared to our American trains, a first class coach holding comfortably about 16 passengers. The locomotives are wood burners, and the speed of the train is from 10 to 12 miles per hour. However, we were quite comfortable on the train and as daylight dawned we were able to catch glimpses of the country through which we were passing.

About 9:30 o'clock in the morning we reached Besitang, where we were obliged to change from the train to the Atjeh Tram. The Atjeh Tram is a miniature steam railway, the track being three-fourths of a meter wide. This is the only track in the Dutch East Indies that is not the standard 1.067 meters wide. The first class coach will hold eight persons but it is crowded at that, particularly so if there is any hand luggage. It seems to be the custom in that section of the world for most of the travelers to take all their luggage with them into the coaches. The transportation of luggage in the Orient is not as simple as it is in America.

We were both surprised and amused when we saw for the first time the "toy train" which was to carry us and our luggage on a two day's journey into the north of the Island. Besitang was a busy stop for us, as it was strictly up to us to see that our luggage was transferred from train to tram, and also to make arrangements for our lunch by phoning ahead to Langsar. The train was to stop twenty minutes at that place, and if the lunch was not prepared in advance and ready to serve immediately, there was not time for it. It was also necessary that we carry our own drinking water as there was none on the tram, and water is very necessary to the traveler in that hot tropical country. When finally our business had been attended to and we were settled in the first class coach, we felt as though we were truly on our way. The locomotive gave a shrill whistle and started off with a jerk and a bang, and almost immediately we were in the tropical jungle. Then out we trundled through rubber plantations and for miles ran between groves of rubber trees, each with its small cup in place for collecting the latex. Then came the date and cocoanut groves and the groves of palm trees, growing long strings of nuts from their crowns. These palm trees are cultivated for their palm oil. Past lovely little thatched huts perched on stilts, through little villages each with its mosque and open walled pavilion where the men of the village meet, between rice fields, we bustled on making about 12 kilometers per hour. On our way we made many stops, and at each one the native men and boys were always on

hand at the station to meet the train, just as they are in many villages in our own country. We were, of course, objects of great curiosity, but met with no rudeness. We reached Langsar about one o'clock P.M. and lunched, then on we rode through the long, hot, dusty afternoon, the country opening up before us in a continuous panorama of the beauties of the tropics.

We were scheduled to reach our night stop about six o'clock, but were more than two hours late, and the conductor had long since lighted his lamps before we came to Lho Seumawe. We put up and had our supper at Hotel Naas. The annoyance of the heat and mosquitoes which we found in Lho Seumawe was an experience long to be remembered.

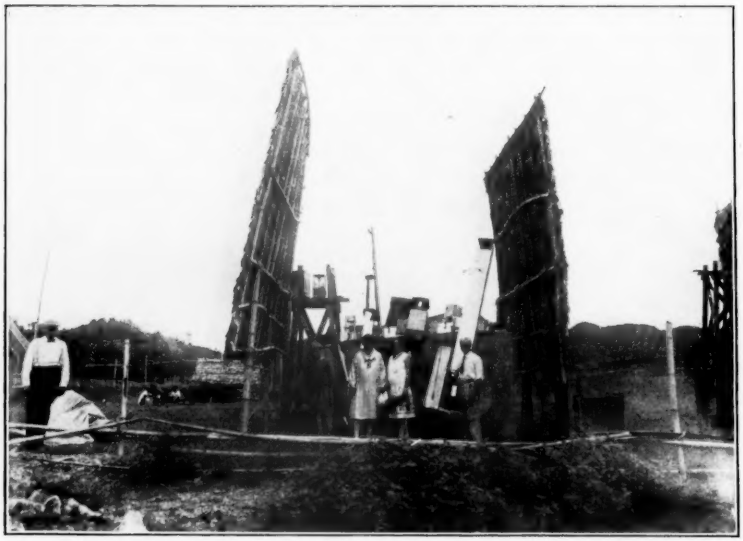


FIGURE 2.
GROUP OF CAMERAS AND OPERATORS.
These cameras, of various focal lengths, were used for photographing the corona.

At six o'clock the following morning we were on the train again and started for Bireuen. For some time we skirted along the shore of the Indian Ocean through palm trees and tropical vegetation, and as the sun mounted higher in the heavens, we beheld on our left the mountains in the distance.

At 9:30 A.M. we reached Bireuen where we were to leave the Atjeh Tram. We were met at the station by members of the Dutch Military, who helped us with our luggage and who had made arrangements for cars to take us overland across the mountains, a distance of more than 100 kilometers to Takengon, which was our destination. The trip was

very delightful. It seemed quite cool after traveling so long at sea level. Through the beautiful tropical mountain scenery, on a good military mountain road, we traveled four hours in a light American car with a speed-crazed Malay driver. We scarcely got a further thrill out of stopping at Blang Rakal, the halfway station in the heart of the big game country, to see a wild tiger that had been captured the night before. When finally we topped a climb and saw before us the beautiful mountain lake, Lho Towar, and the surrounding country, we forgot our nervousness due to wild riding. While we lost the view temporarily as we again dropped down toward it, soon we came out into the town of Takengon, where we were to live and work for more than two months.

Takengon is a Dutch Military station, situated on a beautiful little lake, which forms the eastern end of a small plateau twelve hundred meters above sea level. The village is in the midst of the Atjeh country and the plateau on which it stands is surrounded on all sides by low mountains. The only break in the surrounding hills is a little opening to the southwest where the river Peusangan flows out from the lake.

There are about four hundred native soldiers quartered in Takengon, and the white military consists of a Captain, two Lieutenants, and a Doctor. Besides these military there is the Assistant Residente. There are perhaps as many as half a dozen Dutch planters in the surrounding country. There is a large turpentine factory within walking distance of Takengon. The plantation project in this country is still in a more or less experimental condition. Tea, coffee, and potatoes are the principal things cultivated. The temperature of the plateau is such that garden vegetables of the European type are grown.

Takengon and environs are inhabited by the most peaceful tribes of all the Atjeh district, though we were told that these tribes had not always been so peaceful. It is probable that the nearness of the Military accounts in some measure for the peacefulness of the natives. Not so many years ago cannibalism was practiced among these Gajo tribes. Gajo Kampongs or native villages are scattered all through the neighborhood of Takengon. Each has its Mohammedan Mosque. We had the experience of visiting a number of these native villages. They are very picturesque but far from cleanly.

We were quartered while at Takengon in one of the government rest houses. Our quarters were quite comfortable, although they lacked the modern conveniences found in American homes. The building contained a living room, a dining room, and four large bed rooms, and all nine of the party lived very comfortably as one large family. A retired native soldier and his family were in charge of the house, and they served us as cooks, waiters, bell boys, and what not. The food was wholesome and usually palatable.

There were five white families in the village of Takengon and about an equal number resided on adjacent plantations, but in spite of the small white population, they supported a tiny Club House. The Club House was dedicated while we were in Takengon, and the men of the

German and American Eclipse Expeditions became charter members.

Half a mile from our hotel were the living quarters and camp of the German Expedition and just beyond some three hundred meters lay our own camp constructed on Blang Kolah, the village commons. We were close neighbors to the German Expedition, as we had been in Benkoelen in 1926.

During the erection of our instruments, and later while the adjustments and preliminary drills were in progress a large number of people both native and white visited our camp. The visitors ranged in station from European Royalty to the lowly Malay tiger catcher from the heart of the Sumatra jungle.

FIGURE 3.
SPECTROGRAPHS AND INTERFEROMETERS MOUNTED ON POLAR-AXIS AND USED BY PROFESSOR H. D. CURTIS.

It is almost impossible to speak adequately of the many favors granted to the various eclipse expeditions, by the Government of the Netherlands, and the Netherlands India, and of the courtesies extended to the observing parties by the Dutch residents of Sumatra. The Rotterdamsche Lloyd and the "Nederland" S. S. lines carried all our equipment from New York to Belawan, and on the return from Belawan to Philadelphia free of charge. It was handled with the greatest care, not an instrument was injured, nor a package lost. These same companies carried the official members of the Eclipse Expedition for half the regular fare, from Genoa to Belawan, and from Belawan to New York.

Free railway transportation for instruments and personnel was given

on all government railways of Sumatra during our entire stay. The government of the Netherlands sent Mr. J. Knol, an engineer, to Sumatra in order to select suitable sites for the various eclipse expeditions, to arrange comfortable living quarters, to procure material for the construction and erection of instruments, to arrange for the admission of equipment without customs formality, and to see that all instruments and equipment were forwarded promptly and safely from the port of entry to the railroad station most accessible to the chosen observing site. It is only possible for those who have traveled in an undeveloped country like Sumatra, among a people whose language one speaks or understands only in small measure, to conceive fully how these services, freely given, facilitated our plans and our work.

The Netherlands Indies Sterrenkundige Vereenigung had prepared our lumber and arranged for other material for the purpose of erecting our instruments before any of our observing party had reached Sumatra. The B.O.W., a government commission, which supervises the public works of the country supervised the construction of our buildings.

On reaching Takengon we were met by Lieutenant Kerrekamp, who had been designated by the government as our adviser. He initiated us and smoothed over a multitude of rough places. We are not a little ashamed now when we recall how much we used of his time and good nature freely offered. However, our shame is tempered with gratitude. The Lieutenant arranged every detail, securing workmen, and material for us. Lieutenant Kerrekamp was later transferred to another military post, and Lieutenant DeLange was assigned to act as our adviser.

Lieutenant DeLange visited our eclipse camp every day, straightened out our difficulties, untangled misunderstandings that arose from our meager linguistic equipment, paid our bills, and looked after the details of many arrangements. The services which he rendered us were of almost inestimable value, and will long be remembered.

We shall never forget the social courtesies extended us by the Dutch people living in and near the little mountain town of Takengon. Captain and Mrs. Luteijn, Lieutenant and Mrs. DeLange assisted at the instruments on the day of the eclipse, and before that day gave freely of their time required for the preliminary drills. Dr. J. Vander Laan, Editor of the *Deli Courant*, who had spent some years in the United States, was extremely generous with favors to us.

We are indebted to our own countrymen living in Medan for the valuable assistance and courtesies which they extended to members of our party. Mr. Walter A. Foote, the American Consul, gave us advice, and placed us in contact with those who could help us in many ways. He and Mrs. Foote extended us social courtesies. We shall remember long the generous and efficient treatment of the many calls that we made upon him, some of them extraordinary.

Mr. George F. Seybold, Manager of the U. S. Rubber plantation, and his staff gave us valuable information. He entertained the party at his

home, and gave transportation and entertainment for the party to the Rubber and Tea plantations.

Our camp and the camp of the German Expedition under the direction of Professor Freundlich were separated about two hundred meters. The Germans were about the same distance from us in 1926. The camps were mutually helpful. We interchanged tools, advice, suggestions, building material, and stories. We drank each other's tea and exchanged confidences and meteorological hopes and fears. But we got more than we gave and it is a pleasure to acknowledge our indebtedness.

Chinese carpenters built our tower. The remainder of our labor was native Malay. A native soldier, Tuela by name, was detailed from the military post as a day watchman and laborer. He became camp foreman, and was a very likable and most efficient fellow. He saw to it that our tools were neither lost nor ruined by being left out in the weather. He anticipated the needs of the day and saw that they were provided for. When anyone asked for information concerning camp routine, he was referred to "Professor Tuela" as some of his native friends delighted in calling him.

The program of eclipse observations resembled closely those of former Swarthmore College Eclipse Expeditions. It included:

(1) The making of photographs of the corona. For this purpose we used lenses varying in focal length from thirty inches to sixty-three feet. One of our cameras contained a lens of nine inches aperture and sixty-three feet focal length. This camera was of the stationary type and mounted direct. The plate was moved by clock mechanism to counteract the apparent motion of the sun. This camera was operated by Professor and Mrs. R. W. Marriott. Four lenses of thirty inches, seventy-two inches, eighty-one inches, and one hundred thirty-four inches focal length were mounted equatorially on a polar axis. Mr. J. H. Dugan had charge of the axis on eclipse day, and operated the one hundred thirty-four-inch camera. The eighty-one-inch was operated by Mrs. DeLange, the thirty-inch by Mrs. Luteijn, and the seventy-two-inch camera by Mr. Larry Miller.

(2) We had mounted three interferometers for determining motion in the corona. One of these instruments was designed and built by Professor Wright of Swarthmore College. The other two were designed and built by Dr. H. D. Curtis. There were two spectroscopes, an objective grating spectrograph for flash and coronal rings, and a one-prism spectrograph for determining the position of the Fraunhofer lines in the coronal spectrum. These instruments were in charge of Dr. H. D. Curtis.

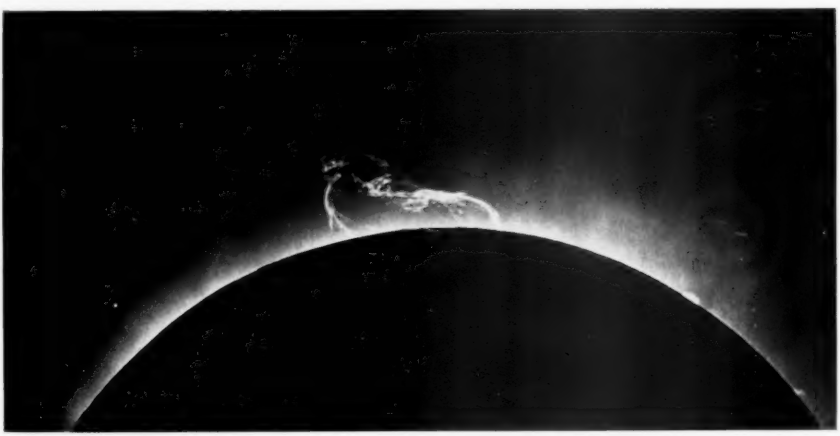
(3) Two lenses of fifteen feet focal length and six and three quarter inches aperture were mounted equatorially on a polar axis to determine the Einstein deflection effect. The mounting and equipment was the same as that used in 1926. The instrument was in the charge of Professor Miller, assisted by Captain Luteijn, Lieutenant DeLange, and our native watchman, Tuela.

PLATE XIV

W

(A) Fine Structure on Limb of Sun, photographed on May 9, 1929, with 63-foot Camera.

E



(B) Large Prominence, photographed on May 9, 1929, with 63-foot Camera.

(4) Walter A. Robinson operated a motion picture camera throughout the duration of the eclipse.

Mrs. J. A. Miller presided at the chronometer, counting the seconds, so that each observer knew at any time the number of seconds elapsed since the beginning of totality.

Every member of the expedition shared in the mounting and adjustment of the instruments; advice was sought and freely given. The one in charge of a given set of instruments naturally felt the responsibility of the final adjustment and behavior of his particular instrument or in-

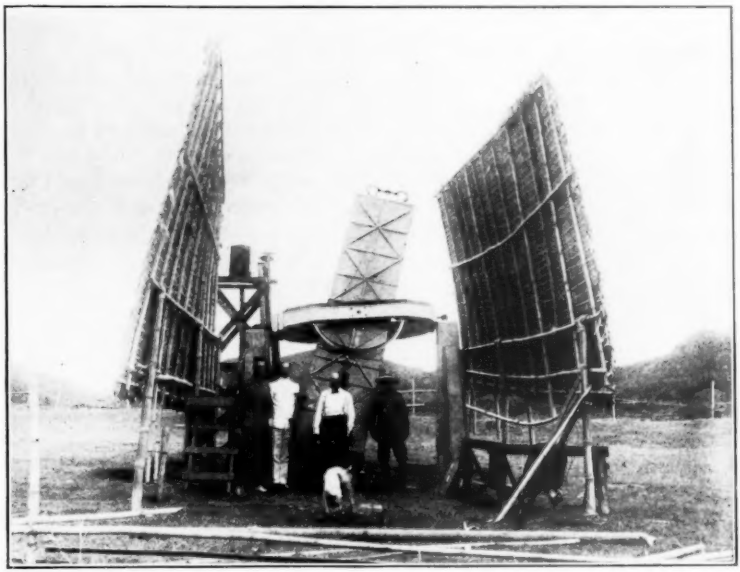


FIGURE 4.

TWIN CAMERAS, WITH WHICH PLATES WERE MADE FOR TESTING THE DEFLECTION OF LIGHT.

struments. The weather was very trying the last three weeks before eclipse day. The last two weeks were cloudy most of the time both day and night. It was with the greatest difficulty, and the expenditure of much time, that we found enough holes in the clouds through which to obtain the focus of our instruments. Though focuses were obtained, we would have felt much more at ease had we been able to test them as final a day or so before the eclipse.

We had not seen a clear sun for days preceding the eclipse. It was at that season of the year known as the change of the Northeast to the Southwest Monsoon. The Southwest Monsoon was to bring clear weather, and it did five days after the eclipse.

The eclipse occurred at 12:47 o'clock. In the morning the sky was entirely overcast. About nine o'clock a round blue patch about 20° in diameter appeared in the southeast sky. It persisted, and seemed to drift slowly toward the completely overcast sun. At eleven o'clock one could tell where the sun was in the sky. Later it was entirely overcast again. At the time of first contact the sun was invisible, but the blue circular patch still drifted slowly on. Sometimes during the partial phase one could tell by using field glasses that the sun was eclipsed. Ten minutes before second contact we took our places at the instruments, having decided to make all exposures regardless of the clouds. At that time one could not tell with the unaided eye that the sun was in partial eclipse. Five minutes before totality it was considerably brighter, and at totality the sun was in the center of the circular blue patch, which to the naked eye seemed perfectly clear. It remained clear during the entire period of totality, then the clear patch moved on, and half an hour after totality the sun was again obscured by clouds.

The corona was beautiful. A long, sharp coronal spike could be traced with the unaided eye to a distance of three solar diameters from the sun, and even farther on the photographic plate. There were three other very long spikes. In addition the photographs showed many shorter and finer streams of normal shape. The form of the corona is well shown in Plate XIII. It is clearly not of the maximum type and it lacks the polar rays and long equatorial streams of the minimum type. There is a quantity of detail in the corona not too far from the sun. Plate XIV (A) shows such a region found on the western edge of the sun, while Plate XIV (B) shows a huge prominence which we dubbed the "Lion Prominence." This prominence was on the eastern limb of the sun.

It will be recalled that the Einstein camera was a twin camera, that is two lenses were mounted in parallel tubes. The first pair of plates was exposed 65 seconds on the eclipse field and the second pair was exposed 70 seconds. We recorded on the second exposure much fainter stars than on the first. Stars as faint as 9.2 magnitude have been found on the best photograph.

An examination of our Einstein plates showed that the clear patch had a greater diameter than we had estimated, for after having exposed on the eclipse field, we shifted the camera, decreasing the declination by 25°, in order to photograph a "check" field on the same plate as the eclipse field. We have found on the plates, stars of this field of 7.8 magnitude. The time of exposure on the check field was 20 seconds. The examination also shows that the sky was clearer at mid-totality than during the first minute of totality. The images show that the clock drove remarkably well and that the atmosphere was not perfectly steady.

These plates will be measured later.

ON THE CAUSE OF JUPITER'S BELTS.

By WM. A. LUBY.

I. Introduction. The belts of Jupiter were discovered on May 17, 1630, by Nicolas Zucchi, a Jesuit astronomer. In the 300 years since then the planet has undergone incessant and careful scrutiny. With the exception of the sun and the moon no other astronomical body has been so continuously observed. Prodigious activity exists on Jupiter and the intimate details of it are well recorded.

Some salient features of the disturbance are:

1. Jupiter's surface moves longitudinally in a manner similar to the motion of the surface of the sun, the rate of rotation being swifter near the equator and decreasing toward the poles. However, the rotation in the northern and southern hemispheres is not quite symmetrical.

2. Two adjacent zones may differ in rate of movement by several hundred miles per hour.

3. Two periodicities in the colors of the belts have been established. The north and south equatorial belts vary oppositely in color, the redness of one increasing as that of the other decreases. Maximum redness in the north equatorial belt occurs at the same time as minimum redness in the south equatorial belt and vice versa. The period of the change is 12.08 years.

A periodicity in the "tawny" color of the equatorial zone of 11.95 years is also established. These two periods differ so little from Jupiter's orbital period that observers are agreed that the actual period of the color changes is the planet's period of 11.86 years. (See W. F. Denning on Jupiter, *Splendor of the Heavens,* Volume 1, page 340.)

In the seeking of causes for the activity on Jupiter two penetrating comments (*Astronomy,* Clerke, Fowler, and Gore, pages 325-6) have been made:

> 1. "This state of things must obviously be maintained by some constantly acting force since friction if unchecked would very quickly abolish such enormous discrepancies."
>
> 2. "Each series in fact of certain classes of markings, such as the equatorial 'portholes' plainly owes its origin to the rythmical activity of a deep buried focus."

Three additional commients may be made:

> 3. The similarity of the rotation in the two hemispheres and above all the parallelism of the belts to the equator indicate a system of forces symmetrically situated with respect to the planet's axis. This could scarcely be the case if the cause were volcanic activity as suggested by Lau.
>
> 4. Definitely periodic phenomena imply an underlying periodic cause. Jupiter's equator is inclined to the planet's orbit only 3° 6'9 and the planet

receives per unit area only 1/27 as much light and heat from the sun as does the earth. Hence a seasonal cause for the observed color changes has not been seriously considered by any one. As possible causes therefore volcanic action and seasonal change are both ruled out.

5. Solar precessional action on the vaporous envelope of Jupiter remains. Though it is "a constantly acting force" and its period is in perfect agreement with that of the color changes it has apparently not been considered as a possible cause. It can be shown, however, that solar precession on Jupiter disturbs the planet's equilibrium and that even a portion of the couple which causes the disturbance is of sufficient magnitude to account for the colossal activity which exists on the planet. The facts supporting this view will now be presented.

II. Precession of a Fluid Ellipsoid. Whether solar precessional forces acting on a rotating fluid ellipsoid can disturb its equilibrium and thus give rise to surface disturbances other than tidal seems to be definitely settled by the work of Lord Kelvin and that of Poincaré. Kelvin concluded without proving it that a liquid ellipsoid with a free surface would, under long period forces, precess as a rigid body.

> "This has been demonstrated by Poincaré, who has verified a prevision of Kelvin that if the period of the disturbing forces is sufficiently long the precession will be practically the same as if the mass were solid." (Lamb, *Hydrodynamics*, pages 677-8.)

What constitutes a short period force as opposed to one of long period is indicated by the following comment on an analogous problem:

> "If the earth consisted of a rigid crust surrounding a liquid mass having an ellipticity of the same order (1/300) as that of the external surface, the condition would be abundantly fulfilled in the case of the luni-solar precession whose period is 26,000 years. On the other hand, the lunar nineteen-yearly nutation would be appreciably, and the solar and lunar nutations of semi-annual and fortnightly (respectively) would be seriously modified by the internal fluidity." (Lamb, *Hydrodynamics*, page 677.)

Hence the solar precessional disturbance of Jupiter is a short period disturbance since it lies well within the nineteen year period regarded by Lamb as a short period force.

In any event, if the precession of a fluid ellipsoid under long period forces is like that of a rigid body and under short period forces it is not, one conclusion inevitably follows: The mobile equatorial protuberance is not rigidly attached to the spherical body beneath and therefore in the case of short period forces does not transmit to it the force of the precessional couple and hence local surface motions must arise and periodic deformations of the ellipsoid must take place.

A suggestive comment on an analogous problem is:

> "If the earth were a relatively thin crust floating on a liquid interior, as was once supposed, it would probably slide somewhat on the interior and give a more rapid precession." (Moulton, *Celestial Mechanics*, page 345.)

In his *Britannica* article on Jupiter, W. F. Denning says: "It is an open question whether the belts of Jupiter indicate a liquid or a gaseous condition of Jupiter."

More recently Jeffeys in the *Monthly Notices* for April, 1923, and May, 1924, has examined the question of the physical condition of Jupiter. One of his conclusions is:

> "To sum up, the available evidence regarding Jupiter and Saturn is consistent with the hypothesis that each is composed of a rocky core surrounded by a layer of ice which is covered by an atmosphere whose depth in one case is about 9 per cent and in the other 23 per cent of the radius of the planet." (*M.N.R.A.S.*, May, 1924, page 538.)

Nine per cent would mean an atmosphere on Jupiter about 4000 miles deep. The equatorial diameter exceeds the polar by nearly 6000 miles. It seems certain that the precessional action of short period forces on such a mass of gas will cause deformations similar to what they would be were the matter in the equatorial belt liquid.

III. The Value of the Solar Precessional Couple on Jupiter. The value of the maximum precessional couple of the moon on the earth as given by Kelvin and Tait in *Natural Philosophy*, Part II, page 411, is:

$$\frac{3\,k\,s\,(C-A)\,\sin d\,\cos d}{D^3}$$

Here s = the mass of the moon, d = the declination of the moon, k = the constant of gravitation, D = the moon's distance from the earth, C — A = the difference of the principal moments of inertia of the earth.

To apply this to the sun and Jupiter, every quantity is known except C — A for Jupiter. To compute C — A some hypothesis regarding the law of variation of the density of Jupiter from center to surface must be made. This may be avoided entirely and an *upper* and a *lower* limit computed for C — A by assuming:

1. That Jupiter is of uniform density (1.32) and liquid.

2. That Jupiter is of uniform density and gaseous with a density equal to air at —140 degrees and 2.65 atmospheres.

(This last is well within known facts since the work of Coblentz indicates that the temperature of the surface of Jupiter is —140° C.)

Using the values given in the appendix to Volume I of Russell Dugan, and Stewart's *Astronomy* for the astronomical constants involved and making the necessary computation give for the upper limiting value of the solar couple on Jupiter: 1.111×10^{32} gram centimeters (A); and for the lower limit 5.011×10^{29} gram centimeters (B).

Thus the minimum limit, which is *well inside the truth, is about twice as great as* 2.809×10^{29} gram centimeters, which is the value of the moon's couple on the earth. The maximum limit is about 400 times the moon's couple on the earth.

A more concrete idea is obtained by expressing the result in metric tons and the diameter of Jupiter as the unit of length. Then the *minimum* is a couple of 35,080,000,000,000 metric tons acting at the ends of Jupiter's diameter. Even a portion of this couple having a *mean* period of 5.93 years seems adequate to cause a tremendous disturbance in

Jupiter's vaporous mobile envelope.

(It can be shown that the precessional effects of the other planets and those of Jupiter's moons are too small to need consideration.)

IV. Position of Jupiter when the Solar Couple has its Maxima and its Minima. The ascending node of Jupiter's equator on its orbital plane is in longitude 135° 25′.81. Since the precessional couple varies inversely as the cube of Jupiter's distance from the sun, the position of perihelion with respect to the nodes of the equator on the orbital plane affects markedly the value of the couple. At the nodes the precessional couple is zero. From Webster's *Dynamics,* page 301:

$$\sqrt{L^2 + M^2} = \frac{3Km\,(C - A)\,\sin l \sin d \sqrt{1 - \sin^2 l \sin^2 d}}{r^3}$$

This gives the value of the precessional couple of the sun on Jupiter.

Here r = Jupiter's distance from the sun. d = 3° 6′.9, the inclination of Jupiter's equator to the plane of its orbit. l = the longitude reckoned from the ascending node of the planet's equator on the plane of the orbit. m = the mass of the sun.

Since *relative* values only are here desired the constants 3K, m, and C — A, the difference of the principal moments of inertia of Jupiter, may be omitted from the calculations.

Making the necessary computations the maxima were found to occur near the solstices. The greater maximum coming near 1905-3-25 and the less near 1911-10-4 (1905.23 and 1911.76).

This gives the intervals between maxima as 6.53 and 5.33 years respectively. The nodes were passed at 1902.70 and 1908.31. The intervals here are 5.61 and 6.25 years. Hence the intervals from node to maximum to node to maximum to node again are: 2.53, 3.08, 3.45, and 2.80 years, respectively. These unequal periods should be discernible in the disturbances taking place on Jupiter. Being unequal it is no wonder that they have escaped detection. But if systematically sought for they should be unmistakably reflected in the position or the width of the various prominent belts on Jupiter or some one or other of the varying phenomena on the planet's surface.

The dates of passage of the nodes and of the maxima are given in Table I in columns A and E respectively.

Column B of Table I contains a summary of results of a long series of observations by Mr. Stanley Williams. His very significant paper on "Periodic Variation in the Colors of the two Belts of Jupiter" was published in *Monthly Notices* for April, 1899. The period obtained was 12.08 years. His results were substantially confirmed by Rev. T. E. R. Phillips in the *Journal of the British Astronomical Association* for October, 1915. The observations of Mr. Phillips covered the years 1899-1915, and are included in Table I.

Mr. Williams (*M.N.R.A.S.*, March, 1920, page 474) gave the results of his observations and those of others on the "Changes of Color of Jupiter's Equatorial Zone." The observations went back 150 years and

were concerned with the "tawny" color of Jupiter's Equatorial Zone. The period obtained was 11.95 years.

TABLE I.

A Dates of Node Passage. (Equinoxes)	B Pink Coloration, Observed dates of Maximum of N and S Equatorial belts	C Tawny Coloration, Observed dates of Maximum	D Tawny Coloration, Computed dates	E Dates of Maximum Precessional Effect (Solstices)
1789.71		1789	1789.25	
.....				
1837.15	1836.36 (S)	1839	1837.05	
				1840.60
1843.40	1843.50 (N)			
				1845.93
1848.01				
				1852.46
1855.26				
				1857.79
1860.87		1860	1860.95	
				1864.32
1867.12	1867.70 (N)			
				1869.65
1872.73	1873.22 (S)		1872.90	
				1876.18
1878.98	1879.72 (N)			
				1881.51
1884.59	1884.03 (S)		1884.85	
				1888.04
1890.84	1891.72 (N)			
				1893.37
1896.45	1897.25 (S)	1898	1896.80	
				1899.90
1902.70	(1903.88) (N)			
				1905.23
1908.31	(1908.95) (S)	1907	1908.75	
				1911.76
1914.56	(1915.97) (N)			
				1917.09
1920.17		1920.5	1920.70	
1926.42				

V. Discussion of the Observations. In Table I, column B, the agreement of the dates of maximum with the passage of the nodes is very striking. The slight disagreements are due no doubt to the period of 12.08 years as against 11.86 and to the observational difficulty of determining the precise date of maximum redness.

Nearly midway between the times of node passage would be the time of equal redness of the north and south equatorial belts. There is no doubt that the equal coloration of the two belts is periodic as is the interesting shift of colors on which Mr. Williams fixed his attention. The period of equal coloration of the two belts would occur twice as often as the maximum of either one alone. This period would be approximately half the planet's period. Actually these periods would be 5.33 and 6.53 years respectively. Equal coloration of the two belts

would be associated with the maximum precessional disturbance, the dates of which are given in column E.

The occurrence of maximum tawny coloration of the equatorial belt is associated with the passage of one node. The remarkable agreement of the dates in column D with *every other* date in column A needs no comment. The only question which arises is why has not the tawny color been observed at the other node also. It seems that it should and its apparent absence may be due wholly to lack of observations.

VI. General Features of the Precessional Disturbance. Jupiter's equatorial protuberance is not rigidly attached to the spherical body of the planet beneath. The equatorial belt itself is not rigid, and hence it will not precess as if it were. The tendency to do so, however, exists. Any displacement so effected by the precessional forces is opposed by the rotation of the planet which tends to maintain the protuberance always in the same position with respect to the planet's axis. Here then is a continual conflict of forces tending to disturb the planet's equilibrium.

The maximum tangential component is found near latitudes $\pm 24°$. The planet is, so to speak, like a piece of material in a lathe acted on by two tools diametrically opposite instead of one. A pressure varying in a mean period of 5.93 years exerts in a given latitude a slowly changing disturbance which decreases from latitudes $\pm 24°$ toward the equator and toward the poles. The origin of the belted effect seems thus clearly indicated.

The precessional disturbance varies inversely as the cube of the planet's distance from the sun. Perihelion comes near longitude 13° and the greater precessional disturbance occurs near 45°, only 32° from perihelion. The summer solstice in the northern hemisphere comes when Jupiter is in longitude 45°.7 and the winter solstice when it is in 225°.7. Hence the greater of the two maximum disturbances comes when Jupiter is in longitude 45° and then the north pole of the planet is tilted *toward* the sun. Therefore, the precessional disturbance in the southern hemisphere is then greater than that in the northern hemisphere. That is the astronomical conditions are such that the integrated total would be greater for the southern hemisphere. Here, then, is a dynamical difference which may explain the existing differences of rotation in the two hemispheres. A contributing factor might be the great Red Spot if it is a coherent mass of material. Another factor, if Jeffeys is correct, is the rocky ice covered core of the planet which is not necessarily either smooth of surface nor an exact ellipsoid of revolution. All of these may be factors in the dissymmetry of motion in the two hemispheres. But certainly one of these factors—the dynamic one —actually exists.

It seems possible to outline certain general features of the motion thus: Consider that part of the *northern* hemisphere of Jupiter on which the sun shines when the north pole of the planet is inclined away

from the sun. Precessional force on material in that hemisphere will have an eastward or a westward component and a southern one. As the planet rotates the east component acting on any definite mass of material decreases to zero and then becomes a west component and in the long run results from the two cancel. The south component is periodic, being maximum along the meridian on which the sun is. Material is pulled southward by the tangential component, compresses the gaseous material before it renders it more dense and thus increases the pressure below. The increase of pressure tends to send material to the point whence the first mass came to restore the diminished pressure there.

Two significant consequences follow: (a) Material moving along the surface southward will fall to the west of the meridian from which it starts and material moving north will pass to the east of the meridian from which it starts. (b) Material sinking toward the center will move to the east of the meridian from which it starts; material rising toward the surface will move to the west of the meridian from which it starts.

Material moving along the surface southward will fall to the west of the meridian from which it starts a distance d_1. Material moving from this region of increased pressure (and density) must move *northward* and reach a distance d_2 east of its original position. The sub-surface motion of this last will mean more energy loss in friction and d_1 will be greater than d_2. That is, if this one shift south and then north were of identical material it would return to the same latitude but slightly to the ***west*** of its original position.

The material forced along the surface southward will increase in density, sink toward the center and move to the east of its original position. Material moving upwards to the region of diminished pressure will move to the west of its original position.

Actually the compensating interchanges will include both types of motion in both hemispheres and for neither does the eastward motion of one balance the westward motion of the other. For the deeper layers of material below the planet's surface somewhat similar conditions hold. The summation of the countless interchanges of the two types described will produce a permanent difference in the rate of rotation of the planet's surface which will in general diminish from the equator to the poles.

The compensating exchanges of material which follow the precessional disturbance of equilibrium and the continual partial restoration of it can not move over great stretches of latitude. The result is the exchanges will be confined to narrow belts parallel to the equator. "As many as thirty have been counted delicately ruling the disc from pole to pole." (*Astronomy*, Clerke, Fowler, and Gore, page 320.)

Any valid conclusions which may be reached regarding Jupiter's peculiar surface motion are of the very greatest importance in connection with Saturn and the Sun.

"The fact that the equatorial belt of Jupiter rotates in a shorter period than in its higher latitudes is a most remarkable phenomenon. If it were an isolated case, one would naturally suppose that the peculiarity was due to irregularities of motion inherited from the time of its origin. Such currents in a body in a fluid condition would be destroyed by friction only very slowly; but the same phenomenon is found in the case of Saturn and the Sun. It can hardly be supposed that the three are coincidences. If they are not the implication is that these peculiarities of rotation have been produced in a similar way." (Moulton, *Introduction to Astronomy*, page 293.)

VII. Latitude Shifts of the Red Spot. It seems possible to connect the observations of the varying latitude of the Red Spot over a series of years with precessional effects in the following manner. From general reasoning it appears that, if an object on Jupiter were floating in or on the surface, the differential effect of the precessional forces should cause it to shift periodically in latitude. If it were south of the equator it should move northward when the north pole of Jupiter is turned toward the sun. Six years later there would be motion southward. Now the Red Spot, whether a coherent mass of gas at low temperature or an eddy, is such an object. In POPULAR ASTRONOMY for January, 1905, G. W. Hough gave the results of twenty-three years of latitude observations on the Red Spot. According to the reasoning which precedes, the Red Spot should have reached its extreme positions in latitude on the dates given in the first column, below. The dates in the second column are those given by Hough in the article referred to on which the Red Spot actually reached the extreme north and south positions.

Precessional Extreme Latitude Position of Red Spot	Observed Extreme Latitude Position of Red Spot (Hough)
1881.65 (n)	1880.5 (n)
1887.85 (s)	1887 (s)
1893.51 (n)	1894 (n)
1899.71 (s)	1897.5 (s)

The agreement in direction of motion is perfect. The agreement in time is good. This extremely important work of Hough cannot be brought to date as it does not appear to have been continued by others. Observers seem to concentrate on longitude variations of objects on the planet's surface.

T. E. R. Phillips gives, however, the following additional results to these of Hough. In the *Journal of the British Astronomical Association*, No. 16, 17, and 18, he gives the position of the Red Spot as follows:

1908-9 —18° 1909-10 —20° 1912 —21°

Now this also is in agreement with Hough's results and this paper. For $1899.71 + 11.86 = 1911.57$ gives the next time after 1899.71 when the Red Spot should be farthest *south*. The agreement in the dates may be even much better than appears for the following reasons. How deep the Red Spot extends below the surface is unknown. Hence its

latitude drifts may be influenced by the sub-surface drift of material opposite to the direction of the surface drift.

VIII. Summary. 1. *"Long"* period forces on a rotating fluid ellipsoid cause it to precess as a rigid body, and *"short"* period forces do not. Consequently the action of short period forces must be divided between precessional results and surface disturbances. This last conclusion may be safely assumed to hold also for a rotating gaseous ellipsoid or one partly liquid and partly gaseous.

2. Lamb concludes that were the earth a fluid ellipsoid enclosed by a rigid crust, the nineteen year lunar precessional period of the moon would be a "short" period. Hence the solar precessional period on Jupiter of 5.93 years (nearly) is a short period.

3. Computation shows that even a portion of the solar precessional couple of the sun on Jupiter is sufficiently great to supply the moving force necessary to account for the activity on Jupiter.

4. The period found for the color changes in Jupiter's north and south equatorial belts is the period of the planet's revolution round the sun from equinox to equinox. Seasonal explanation of the phenomena is not accepted by any astronomer and no explanation of this periodicity has heretofore been offered.

5. The shift in latitude of the Red Spot agrees with expected precessional action upon it.

6. The equality in redness of the two equatorial belts is connected with the time of maximum precessional disturbance (the solstices), and the periods would be the precessional periods.

7. A dynamic reason can be given for the belts and the decrease of the rate of rotation from equator to the poles of Jupiter's surface.

8. Precessional disturbances in the two hemispheres are not quite equal and this gives a dynamic reason for the slightly unsymmetrical distribution of motion in the two hemispheres.

9. A similar type of action is present on Saturn and the Sun. (Precessional action of the planets on the Sun as a possible cause of the sun spots will be treated in another paper.)

CANCER.

This is the sky-crab, named of old,
Because here, so Chaldeans told,
The sun seemed to move backward. These
And other tales about him teem
Of mangers, hives, and gods. If dream
They are delightful fantasies.

1490 Stuart St., Denver, Colorado. LILIAN WHITE SPENCER.

THE METEOR OF JULY 25, 1929.

By C. C. WYLIE.

This meteor, which fell at 9:46 P.M. Central Standard Time, has been reported from O'Neill, Nebraska, west, and Cottonwood, Minnesota, northwest, to Detroit, Michigan, and Columbus, Ohio, east, and Marissa, Illinois, south. (See map for locations of Cottonwood and Marissa.) The reports from the extreme west and northwest, evidently observations of this meteor, were secured by the Weather Bureau. Mr. Charles D. Reed, senior meteorologist of the State Weather Bureau, has coöperated in collecting information on this brilliant meteor, and forwarded to us the material received. Dr. D. W. Morehouse, president of Drake University, also received numerous letters, which he has kindly forwarded to us. Information has been received from the states of Illinois, Indiana, Iowa, Michigan, Missouri, Minnesota, Nebraska, Ohio, Wisconsin, and South Dakota. This by no means represents the area over which it was visible. Rather it represents the area over which Mr. Reed and the Department of Astronomy at the University of Iowa can collect information. If we assume that the meteor was seen as far in other directions as it has been reported to the west and northwest, and it should have been with proper weather conditions, it was seen also in Alabama, Arkansas, Canada, Georgia, Kansas, Kentucky, Maryland, Mississippi, New York, North Carolina, North Dakota, Oklahoma, Pennsylvania, Tennessee, Virginia, and West Virginia. It lighted up nearly a million square miles of territory, a remarkable record.

Because of its great brilliancy, it gave the majority of observers the impression of being quite close. At the Yerkes Observatory some astronomers felt an impulse to dodge when they saw the meteor coming directly toward them, although it seems to have disappeared from view at a distance from them of about fifty miles. Near Milwaukee, coast guard men on the edge of Lake Michigan thought they saw a "flaming airplane diving into the lake." Even in Nebraska, a group was sitting in an unlighted room when "the whole house was lighted up with such an intense bright red light, and all exclaimed at once, 'what was that?' Our first thought was that it was the light from a car thrown just right"; and careful reports from that state include that the observer thought the meteor must have fallen within half or three-quarters of a mile, some reporting even closer. Many letters from Iowa and western Illinois contain such expressions as "it fell directly east of us, seemed to be just across the road." An interesting illusion, of a type reported on several earlier meteors, is given in a letter from Omaha, Nebraska: "I saw a ball of fire come through the top of a tree in the next yard. It created a blaze about a foot high and burnt off several branches, then falling to the ground."

The large arrow on the accompanying map shows the computed path in our atmosphere, the figures beside the arrow being the height in miles above the surface of the earth. The path was computed from,—first, the observations of astronomers at the Yerkes Observatory, as communicated by Professor Stebbins in a letter; and second, from several determinations of the altitude and azimuth of points of appearance and disappearance for places in eastern Iowa. These were measured in most cases with a transit, by an experienced person, who interviewed the observer at the exact place from which the meteor was seen.

At Iowa City, seven sets of measures were taken for altitude and azimuth. Numerous other observers were interviewed, but measures were taken only when it appeared the observer could point out the path quite well. Some observers were interviewed in Clinton and measures were taken on the path as recalled by two who observed it from the same place. Measures were taken on one observation in Muscatine, but the azimuth is weak because it was from the inside of a house, where the compass is of little value and the alignment of the house was not

checked from outdoors as carefully as it should have been. Father John Theobald, of Columbia College, took five sets of measures from Dubuque. Mr. J. Hansen furnished four sets from Bettendorf. Mr. Benton R. Anderson, City Engineer of Clinton, measured the angles for his own observation. Miss Ruth Berry of Toulon, Illinois, furnished measures (not with a transit) from which the angles for her observation could be computed. The point of disappearance is further checked by several rather careful reports in addition to the measures. Mrs. George Vollbehr of Morrison, Illinois, reports that it fell due east. Professor E. R. Becker of Iowa State College, Mrs. Becker and Miss Lucille Stoddard of Sterling, Illinois, observed it from two different stations in Sterling and agree that it disappeared nearly due east. Professor E. B. Paine, of the College of Engineering of the University of Illinois, observed the meteor from the Seventh Avenue Bridge, Grant Park, Chicago. His report is that the meteor disappeared due west, or a little south of due west.

One report from very close to the actual point of disappearance has been secured. Mr. V. R. Wetzel, jeweler of Sycamore, Illinois, was on a highway about ten miles north and a little east of De Kalb, driving south. He reported that the meteor disappeared in the southeast and when asked, stated very definitely that it did not go as far north as due east of his point of observation.

Among the first reports received was an apparently careful, but discordant report from an amateur astronomer in Bettendorf. In our acknowledgment we thanked him, but remarked that it did not agree with other careful reports. He quickly sent a second letter, stating that his first azimuth was "merely a guess" and gave a revised figure agreeing well with others we have. His first figure placed the point of disappearance too far north.

The bright meteor itself came low enough, (about 24 miles is our figure) that it seems possible meteorites* might have fallen from there to the surface of the earth. Meteorites fall through our lower atmosphere as dark bodies, not as balls of fire, and as this fall occurred at night they would not be seen. Our guess would be that no stones larger than ten or fifteen pounds reached the surface of the earth, and as several square miles of country must be searched their recovery will be improbable.

A thunderstorm had been in progress in the vicinity of De Kalb just before the fall of the meteor and there were still occasional flashes of lightning. This makes it more difficult to secure reports from that section than from western Nebraska, four hundred miles from the real path.

The letters show that some other fairly bright meteors were seen that evening, which should not be considered unusual for late in July.

*The bright fireball seen in the atmosphere is a meteor. The individual bodies reaching the surface of the earth are meteorites. A brilliant meteor may scatter meteorites over several square miles of territory.

For example, Mr. Fred E. Allender, of Davenport, sends a sketch of the path of one observed at 11:25 P.M., which was perhaps brighter than Venus; but no one else has reported this particular meteor. The evidence at hand indicates only one fireball of great brilliance was seen that evening. Most of the estimated times are 9:30 to 10:00 o'clock; and the times where it is stated a watch was consulted differ by less than five minutes from the Yerkes 9:46. One of the most noticeable discrepancies was a report that a brilliant object was observed at 10:21, just as a certain train was pulling out; but the local weather man reported the train pulled out at 9:45 that evening, showing the same meteor was observed.

Numbers of people in all sections were driving or sitting on porches for a considerable time. All of these appear to have seen the same object, and none report two brilliant meteors. The descriptions of direction, brightness and apparent motion of the object seen agree satisfactorily with the assumption that the same bright fireball was seen by all.

The last sentence should perhaps be qualified, for a first reading of the reports from a single city might well lead a person to believe a whole flock of fireballs had been observed. Let us illustrate by several reports from Davenport, all fictitious but of typical letters we receive from the general public. A reports that the meteor appeared in the southeast, went down across the eastern sky, disappearing at a point about 20 degrees north of due east; which is substantially correct. B sees the meteor, but has in mind only the general direction and reports that it "fell due east." C observes the meteor, and notes that it disappeared 20 degrees north of due east, but still at some distance above the horizon. He estimates, by projecting the path on toward the horizon, the point of striking, and reports that the meteor "fell 35 degrees north of east." D believes that the meteor was travelling about due north (correctly), and reports that "a bright meteor appeared in the southeast and went due north." E is also concerned with the direction of travel; but he mentally places the meteor when first seen at approximately the correct distance, since it looks like merely a bright shooting star, while at the end he has the impression it must be very close, only a few hundred yards away. He therefore pictures the meteor as travelling in a general way from Champaign toward Davenport, or northwest. His report is therefore that "a brilliant meteor appeared in the eastern sky and went northwest." This type of report is frequently received. F sees the meteor appearing in the southeast and disappearing in the northeast, and reports that "the meteor appeared in the southeast and went northeast." G is driving on a highway a few miles west of the city, and sees the brilliant meteor fall, as he believes, only a few hundred feet away. He, therefore, sends us a letter, from his Davenport address, reporting that the meteor "fell due west of Davenport." (G may report any direction depending on where he is driving). H sees a good bright shooting star, and noticing the request for information reports that. It may obviously be in almost any direction. There are, of course, some reports

which are simply errors, as investigation has shown. If time and general description agree with others from the same community, but the direction is 35 or 45 degrees different, it is reasonable to assume this is an error. Our angling roads and streets are responsible for many such mistakes.

Because it is difficult to be sure of the correct interpretation when letters are ambiguous, it has been our practice to make the provisional assumption that only one brilliant meteor was seen, and compute its path from the reports of experienced persons only. With this path before us, the letters are examined for evidence of additional brilliant meteors. The interpretation of most apparent discrepancies is then obvious, but follow-up letters requesting additional information are occasionally sent. We explain that we are not sure our interpretation of their letter is correct, and ask, for example, whether when last seen the meteor was in a direction a little north of due east of where they were standing. The reply may make it perfectly clear that the brilliant meteor was observed. Or it may make it clear that a bright shooting star has been reported. One of our first follow-up letters on this meteor was answered with "The meteor which I saw couldn't possibly be the one in question . . . The one which I saw was nothing more than a brilliant shooting star." Sometimes an evidently successful business man will evade answering the direct and simple question, and send a second meaningless letter. In such cases, the matter is dropped. In many instances, of course, our letters are not answered. One letter contained the paragraph, "People in H. saw it west of them and those coming from S. saw it north of them. He (Mr. R.) saw it southeast of him—so it must have been in that vicinity." In our follow-up letter we asked if it would be possible to get the names of some residents of H. who saw it to the west, and of residents of S. who saw it north so that we could make an investigation. We also told her that a preliminary report on the brilliant meteor which fell the same evening was enclosed. Some items in this story made us question the reality of the supposed fall in that community, so we are not surprised that no answer to our follow-up letter has been received to date. Later investigation in the town of S. indicates that the report was erroneous. The important thing is that our letters have as yet brought in no evidence that more than one brilliant object was seen that evening.

Five reports of supposed meteorites from this fireball have been noticed. All, of course, are from points more than 100 miles from the actual place of disappearance of the meteor. Persons much nearer than that saw the fireball disappear high in the sky, and did not have the illusion that it fell very near. The first was from Chariton, Iowa, south of Des Moines, and about 260 miles from the place where meteorites will be found, if any are recovered. It reads as follows: "Last Thursday night about 10:30, Mr. and Mrs. John Doe (name changed) were driving east of Chariton . . . when they saw a meteor or shooting star which passed across the road about 30 feet from their car. It appeared

as a ball of fire with a tail about eight feet long. Friday morning, Mr. Doe drove out to the spot where the shooting star had been seen . . . The shooting star was brought to town, the grass cleaned out of its surface and it is now on exhibition at the Ritz barber shop. It has shot its last shot and henceforth will make a good exhibit for a museum."

The duration must have been quite short. Estimates in letters run from one second up to almost anything, the more carefully reported observations perhaps averaging three seconds. Wherever there is a story of definite action, it indicates the duration must have been very short. For instance, at Muscatine, a lady was sitting in front of the door, and her husband was lying on the davenport near-by. As the meteor appeared she exclaimed, "Oh! Oh John, come and see this big rocket." John bounced up and across to the door as quickly as possible, arriving in time to see,—nothing. Even the train had vanished. In Iowa City a couple had just retired, when the wife, looking out of the window saw the meteor appear. She called to her husband, and he succeeded in turning over in time to see the train for an instant, but not the bright ball of fire. Stop-watch determinations having people attempt to "reenact the scene" give for the duration of the brilliant illumination at Iowa City a little under two seconds, and determinations for the full path average under three seconds. Father Theobald, of Dubuque, sends an estimate of three seconds for the duration, after interviewing several observers. The Weather Bureau observer at Mason City, from a number of interviews and reports writes "The length of time it was observed was very short, estimates having been given from one to possibly three seconds." On the other hand, Professor Joel Stebbins estimated "five or six seconds" for the duration. Mr. Hansen, of Bettendorf, an amateur astronomer with considerable experience counting seconds, counted on the flight of this meteor, and repeated the count with a stop watch, obtaining five seconds. If we adopt three seconds, as the time from Champaign to De Kalb, the distance travelled was about 150 miles, and hence the velocity was about 50 miles per second, a distinctly hyperbolic result. If we adopt five seconds, the result is 30 miles per second. It has been found that a stop-watch determination is nearly always less than the observer's estimate. The apparent motion of a brilliant and distant meteor is exceedingly slow as compared to that of an ordinary shooting star, and this perhaps causes the duration to be overestimated.

Many letters report a swishing or hissing sound. Some report other noises; but we often have from the same community a definite report that no sound was audible to some one sitting on a porch where everything was quiet. Further, there is no mention of an appreciable interval of time between the appearance of the meteor and the hearing of the sound. In all cases, the interval should have been minutes. Hence, none of these sounds can be accepted as from the meteor.

University of Iowa, October 5, 1929.

THE METEOR OF JUNE 25, 1929.

By C. C. WYLIE.

On the evening of June 25, soon after the conclusion of a lecture on "Stellar Systems," by Professor Joel Stebbins of the University of Wisconsin, a bright meteor was seen rather low in the northeast by Professor C. J. Lapp of the Physics Department of the University of Iowa. The time was taken as 9:34 P.M. C.S.T., and the apparent path among the stars noted with care so that it could be drawn on a star chart at the first opportunity. The brightness was estimated as first magnitude at the start, and as definitely brighter than Venus at greatest brilliancy at the end. The duration was estimated as one and one-half to two seconds. As Professor Lapp has had some years of experience timing track meets, this should be given greater weight than the estimate of an average observer.

Requests for information brought in several reports, only one of which appeared to be of the same object. This was a careful drawing of the path as seen by Mr. William Bunn, of 852 Newall Avenue, Muscatine, Iowa. The drawing shows estimated altitude and azimuth. The solution for real path was made assuming Professor Lapp's observation perfect, and reducing Mr. Bunn's estimated altitudes some to bring agreement. The resulting path in our atmosphere is shown by the short arrow on the map accompanying the article on the bright meteor of July 25, page 515. The June 25 fireball was first noticed from Iowa City when at a height of about 65 miles nearly over a point on the shore of Lake Michigan 10 miles north of Milwaukee, and disappeared at a height of about 30 miles over a point 13 miles east and slightly north of Madison, Wisconsin. The velocity, using Professor Lapp's estimate, comes out to be between 40 and 53 miles per second.

UNIVERSITY OF IOWA, AUGUST 22, 1929.

AN INTERESTING TRIPLE STAR.

By SAMUEL G. BARTON.

The star BD +29°4193, $\alpha = 20^h\,46^m\,51^s$, $\delta = +29°\,21'$ (1950) consists of three stars which form a nearly equilateral triangle. They suggest the equilateral triangle solution in the problem of three bodies. Two discordant plates of the Oxford Astrographic Catalogue and measures by the writer on three nights with the 18-inch refractor here give the following results:

		AB		AC		BC	
Astrographic	1897.69	354°2	6″5	54°2	6″2	116°6	6″4
Barton	1929.75	356.5	6.61	47.1	5.81	116.4	5.23

The magnitudes of the stars given in the Astrographic Catalogue are 8.7, 10.2, and 11.3. These seem to be about correct. The magnitude as a single star in both the BD andA.G. Catalogues is 8.7.

FLOWER OBSERVATORY, UNIVERSITY OF PENNSYLVANIA,
October 9, 1929.

FORTY-SECOND MEETING OF THE AMERICAN ASTRONOMICAL SOCIETY.

The forty-second meeting of the Society was held in Ottawa, at the Dominion Observatory, August 26-29, 1929, on the invitation of the Minister of the Interior and the Director of the Observatory.

There were many evidences of thoughtfulness for the comfort of the Society and the success of the meeting. Even a partition had been removed to make a larger lecture room in the Observatory. This was to be replaced after the meeting.

Our hosts provided also a large portion of the scientific nourishment. One-half of the papers were contributed by Canadian authors. A number of general papers on the history and plan of work of the two government Observatories, the Coast and Geodetic Survey, and the investigations in seismology, gravity, and terrestrial magnetism formed an attractive feature of the program. These were followed with papers by individual staff members. The Society had the opportunity to appreciate the work in astronomy and related subjects that is being done in Canada while the authors had reasons to be satisfied with their stock-taking. The entire program contained forty-seven papers and was carried through in five sessions.

In his lecture, "Engineering in Astronomy," on Wednesday evening, under the joint auspices of the Ottawa Centre of the Royal Astronomical Society and the American Astronomical Society, Mr. J. W. Fecker gave a very clear and instructive talk on the making of telescopes and domes.

The reception at the Observatory on Tuesday evening provided mental as well as social and physical entertainment. Members of the staff distributed about the building were easily started on instructive talk of their work. It was interesting to find so much emphasis necessarily placed on what the man in the street would call "useful" astronomy. The other kind of astronomy is not neglected.

On Wednesday afternoon a stream of cars with the Director at the head swept through the ample spaces of the Ottawa drives. Some of the units became detached en route but all recombined for the garden party on the Observatory grounds.

The dinner on Thursday evening at Chateau Laurier was a real banquet with pretty decorations, a clever menu, toasts to the King of Eng-

land and the President of the United States, good speeches, and good food, all provided at a suspiciously low price. President Brown presided in happy vein and after a lecture on astronomy introduced the other speakers. Mr. R. A. Gibson and Mr. J. D. Craig spoke for the Department of the Interior. The former hoped that astronomers would continue their study of the influence of the full moon with special reference to older people. The latter offered to find any lost star provided that it had been used in the determination of the international boundary. Mr. Stewart heartily approved of the astronomical meetings and of more funds for his observatory. Mr. Chant hoped that he could soon have a meeting at Toronto and that members would follow his example in forming early the go-to-meeting habit. Mr. Milham described a good after-dinner speech and then showed how it was done. The "substantial" part was an interesting description of the instruments at Pekin. Mr. Kovalenko reviewed some of the papers: that the one indispensable instrument for an eclipse expedition is an umbrella; that sun-spots are connected with almost everything and that it is to be hoped that astronomers will discover their connection with the stock market; and that some curves are not as smooth as others.

Mrs. Stewart kept open house during the meeting with bridge tables, tea table, and restful chairs.

Mr. De Lury wrestled manfully with the problem of the newspaper interpretation of the program.

The annual business meeting of the Society was held Thursday morning.

The secretary made his report for the Society and the Council: A committee consisting of Messrs. C. G. Abbot, F. B. Littell, and Wm. Bowie, *chairman*, has been appointed to consider the advantages of coöperation with the International Scientific Radio Union. Messrs. D. W. Morehouse and C. C. Wylie have been appointed representatives of the Society on the Council of the A.A.A.S. for the Des Moines meeting of December, 1929. The election of an honorary member of the Society has been made unfinished business for the December, 1929, meeting. The accounts of the secretary and of the treasurer have been audited and found correct. The report of the committee on revision of the Constitution and By-laws has been submitted to the Council and in amended form printed and distributed to all members of the Society in accordance with the provisions of the Constitution. Fourteen new members have been elected to the Society:

Edward G. F. Arnott, 126 Graduate College, Princeton, N. J.

Miriam S. Burland, Dominion Observatory, Ottawa, Canada.

F. W. Darling, U. S. Coast and Geodetic Survey, Washington, D. C.

A. Vibert Douglas, Macdonald Physics Laboratory, McGill University, Montreal, Canada.

C. Dana Higgs, Fontana, Wisconsin.

Charles J. Krieger, Mathematics Department, St. Louis University, St. Louis, Missouri.

I. Maizlish, The Louisiana Academy of Sciences, Centenary College, Shreveport, Louisiana.
Ray S. Neidigh, Elgin Observatory, Elgin, Illinois.
John L. O'Connor, Dominion Observatory, Ottawa, Canada.
Robert M. Petrie, 1308 E. Ann Street, Ann Arbor, Michigan.
James Robertson, Naval Observatory, Washington, D. C.
Arthur Snow, 1656 Newton St., N. W., Washington, D. C.
Alice W. Turner, Mathematics Department, University of Toronto, Toronto, Canada.
N. E. Wagman, 3218 Wisconsin Avenue, Washington, D. C.

The Council has accepted the invitation to hold the forty-third meeting in December, 1929, at the Harvard College Observatory.

Miss Harwood, Messrs. De Lury and McLaughlin were appointed tellers for the election. The total number of votes cast was 149. The returns showed substantial majorities for those whose names were printed on the official ballot.

The Society then proceeded to the consideration of the new Constitution and By-laws, which was unanimously adopted (including five mail votes) after a short discussion centering round the continued usefulness of ex-presidents.

Nine nominations were made for the nominating committee provided for by the new Constitution and the written ballot, with Messrs. Elvey and Henroteau acting as tellers, resulted in the election of Miss Furness, Messrs. Curtis and Littell. The president requested Miss Furness to act as chairman.

The offices to be filled are vice-president, secretary, treasurer, five councilors (three for three years, one for two years, one for one year) and representative on the National Research Council. The committee will doubtless be glad to receive suggestions, especially in view of the fact that the new Constitution permits two nominations for each vacancy.

As the Society has expressed a desire for a choice of candidates it is to be expected that every member will vote, that the nominees will go through with the election as good sports, and that there will be no sting in defeat.

The make-up of the present Council is as follows:

President	E. W. Brown	1928-1931
Vice-Presidents	V. M. Slipher	1928-1930
	R. G. Aitken	1929-1931
Secretary	R. S. Dugan	1929-1930
Treasurer	B. Boss	1929-1930
Councilors	R. H. Curtiss	1927-1930
	M. Harwood	1927-1930
	F. B. Littell	1928-1931
	F. E. Ross	1928-1931
	E. S. King	1929-1932
	F. H. Seares	1929-1932

Ex-Presidents	W. W. Campbell	1925-1931
	G. C. Comstock	1928-1934

The representatives on the National Research Council are:

Frank Schlesinger	1927-1930
W. S. Adams	1928-1931
W. S. Eichelberger	1929-1932
S. A. Mitchell	1930-1933

The following members were present at the meeting:

Sebastian Albrecht
Leah B. Allen
Weld Arnold
H. F. Balmer
Ida Barney
E. W. Brown
Miriam S. Burland
H. E. Burton
C. A. Chant
R. H. Curtiss
R. E. De Lury
David Dietz
A. Vibert Douglas
R. S. Dugan
W. J. Eckert
C. T. Elvey
A. S. Fairley
J. W. Fecker
Clyde Fisher
Caroline E. Furness
A. Estelle Glancy
J. C. Hammond
Margaret Harwood
J. P. Henderson
F. Henroteau
F. C. Jordan
M. F. Jordan
E. M. Justin
L. V. King
H. R. Kingston
M. S. Kovalenko
Charlotte E. Krampe
Eleanor A. Lamson
Mrs. Isabel M. Lewis
F. B. Littell
Hazel M. Losh
D. B. McLaughlin
Laura Hill McLaughlin
J. E. Merrill
W. I. Milham
H. R. Morgan
W. W. Morgan
J. J. Nassau
J. L. O'Connor
Jesse Pawling
J. A. Pearce
G. H. Peters
Frances L. Seydel
C. C. Smith
R. M. Stewart
James Stokley, Jr.
Otto Struve
Alice W. Turner
R. N. Van Arnam
C. B. Watts
R. K. Young

Those present as guests included:

J. H. L'Abbe
Mrs. Sebastian Albrecht
Naomi Albrecht
Sebastian Albrecht, Jr.
Mrs. H. E. Burton
Mrs. C. A. Chant
W. G. Colgrove
J. D. Craig
Miss L. D. Cummings
J. Y. Dickson
W. A. Dier
Mrs. David Dietz
J. F. Dolan
Miss M. E. Douglas
W. W. Doxsee
Mrs. R. S. Dugan
Priscilla Dugan
Mrs. A. S. Fairley
Mrs. J. W. Fecker
C. A. French
Miss Florence E. Frisby
R. A. Gibson
Miss M. P. Gilman
J. C. Glashan
A. W. Grant
Richard Hamer
Mrs. J. C. Hammond
A. H. Hawkins
R. H. Hawkins
G. V. Helvig
Mrs. F. Henroteau
E. A. Hodgson
Mrs. F. C. Jordan
J. W. Jordan
W. M. Kenny
Mrs. H. R. Kingston
Mrs. M. S. Kovalenko
J. L. Lane
R. W. Lewis
Mrs. F. B. Littell
C. H. Littell
Mrs. Mary F. Losh
F. H. Lynch
W. S. McClenahan
R. J. McDiarmid
Mrs. R. J. McDiarmid
Isobel McDiarmid
Miss G. MacDonald
Mrs. J. E. Merrill
A. H. Miller
Miss K. Nevins
D. H. Nelles
D. B. Nugent
N. J. Ogilvie
Mrs. R. H. Robertson
O. Sills
Mrs. R. M. Stewart
Mrs. J. A. Thomson
Mrs. C. B. Watts
C. R. Westland
Miss Henrietta Young

PLANET NOTES FOR DECEMBER.

By CLIFFORD E. SMITH.

The *Sun* will be moving southeast until December *22*, the occasion of the Winter Solstice. The Winter Solstice marks the beginning of winter, and at that time the sun will start northeast again. During this period the sun will cross Ophiuchus and move to the central part of Sagittarius. The position of the sun on December 1 and on December 31 will be respectively: R.A. $16^h\ 29^m$, Decl. $-21°\ 42'$; and R.A. $18^h\ 38^m$, Decl. $-23°\ 9'$.

The phases of the *Moon* will occur as follows:

First Quarter	Dec.	9 at	4 A.M.	C.S.T.
Full Moon		16 "	6 A.M.	"
Last Quarter		22 "	8 P.M.	"
New Moon		30 "	6 P.M.	"

The moon will be at apogee on December 5, and at perigee on December 17.

Mercury will be near the sun in apparent position early in the month, but by the end of the month it will set about an hour and a quarter after the sun. On December 14 it will be in conjunction with Saturn.

Venus will be approaching the sun in apparent position. By the end of the month it will rise about a half hour before the sun. On December 30 it will be in conjunction with the moon, and also it will pass through its descending node.

Mars will be near the sun in apparent position, conjunction with the sun occurring on December 3.

Jupiter will be in central Taurus. During this period its apparent motion will be retrograde. Early in the month it will be on the meridian about midnight, opposition occuring on December 3. It will be in conjunction with the moon on December 15.

Saturn also will be near the sun in apparent position, conjunction with the sun occurring on December 25.

Uranus will be in central Pisces. Its apparent motion will be in retrograde until December 17, when its apparent motion will become direct again. During the latter part of the month it will be on the meridian about 6:00 P.M. Standard Time, quadrature east of the sun occurring on December 29.

Neptune will be in Leo a few degrees from Regulus. Its apparent motion will be direct until December 6, thereafter during the month in retrograde. On December 21 it will be in conjunction with the moon. During the middle of the month it will be on the meridian about 4:30 A.M. Standard Time.

OCCULTATIONS.

Occultations Visible at Washington.

[From the *American Ephemeris.*]

Date 1929	Star's Name	Magnitude	IMMERSION Washington C.T.	IMMERSION Angle from N	EMERSION Washington C.T.	EMERSION Angle from N	Duration
			h m	°	h m	°	h m
Dec. 6	35 Capricorni	6.0	16 3	56	17 33	244	1 30
13	53 Arietis	6.0	19 42	26	20 44	268	1 3
14	A Tauri	4.5	18 20	67	19 22	240	1 3
14	39 Tauri	6.1	18 35	95	19 30	212	0 55
18	c Geminorum	5.5	3 20	131	4 26	262	1 6
19	57 B. Leonis	6.5	23 45	84	0 48	315	1 3
24	θ Virginis	4.4	1 9	148	2 1	272	0 52

Prediction of Occultations for Amherst, Mass., and Vicinity.

(Disappearances Only)

Date 1929	Star	Mag.	G.C.T.	a	b	P
			h m	m	m	°
Dec. 14	53 Arietis	6.0	1 1	—0.6	+2.5	26
14	A Tauri	4.5	23 36	—0.6	+1.6	67
14	39 Tauri	6.1	23 53	—1.1	+1.1	96
18	c Geminorum	5.5	8 27	—1.3	—1.5	114
20	57 B. Leonis	6.5	5 5	—1.0	+2.3	69

The G.C.T. of the occultation at some other station within 300 miles of Amherst may easily be found from the coefficients a and b and the formula

$$\text{G.C.T.} = \text{Predicted G.C.T.} + a\Delta\lambda + b\Delta\phi,$$

where $\Delta\lambda$ is equal to the longitude of the place (to tenths of a degree) minus the longitude of Amherst (72.5 degrees) and $\Delta\phi$ is equal to the latitude of the place (likewise to tenths of a degree) minus the latitude of Amherst (42.2 degrees). For distances up to 300 miles the error of this formula will rarely exceed 2^m.

ROY MARSHALL.

Detroit Observatory, Ann Arbor, Michigan.

COMET NOTES.

By G. VAN BIESBROECK.

We are entering upon another quiescent period in cometary activity.

COMET 1929 *b* (NEUJMIN) is no longer observable now. From *Lick Observatory Bulletin*, No. 417, we learn that the Berkeley computers experienced great difficulties in representing the earlier observations, which had been announced as apparent places. They find that the first position mentioned on p. 473 of last month's issue was a mean place instead of an apparent one, and that the elements III given on the same page represent as well as possible the observations extending to September 9. No later positions have been published so that the visibility will have lasted less than six weeks, unless the comet can be traced back on plates taken before the discovery (August 2) by means of the following ephemeris computed at Berkeley:

	h m s	° ′	M
July 4	21 20 13	−11 23.2	14.2
12	20 58	11 31.4	
20	20 10	11 50.7	
July 28	21 18 9	−12 19.4	14.1

The other comet announced in the beginning of August, namely 1929 *c* (FORBES), was brighter than the previous one and was well observed in the southern hemisphere. From our failure to find the comet near the position resulting from the parabolic orbit we suspected last month that the orbit would turn out to be elliptical. This has now been confirmed by several computers.

ELLIPTIC ELEMENTS OF COMET FORBES.

Perihelion (U. T.) 1929	June 28.720	June 25.86	June 26.619
Perihelion to node	264° 24′	259° 16′	260° 18′.6
Node	24 7	25 34	25 5.6
Inclination	4 41	4 38	4 39.6
Eccentricity	0.5536	0.5558	0.55706
Perihelion distance	1.5401	1.527	1.5327
Period in years	6.408	6.37	6.437
Computer	R. T. A. Innes	B. Dawson	A. C. D. Crommelin

Thus another short-period comet is added to the list. The orbit obtained by B. Dawson was received by wire in the afternoon of October 1. The resulting position was at once computed and shortly after sunset the writer secured a pair of plates with the 24-inch reflector on which the object was found near the predicted place. It appeared as a small round coma followed by a faint broad tail about 1′ in length. Further observations were secured visually with the 40-inch refractor on October 2 and 4: the total brightness was equivalent to that of a 14^{M} star; on the plates taken October 1 it appeared about one magnitude fainter photographically; there was also noted a 15^{M} nucleus but this was fuzzy and elongated in the position angle 95° which was also the main direction of the short tail.

The observations now cover an interval of two months, which will give a fairly well established orbit. Further measures would be of great help in making a safe prediction for the return in 1936, but the object is getting so faint that it is doubtful whether it will be seen any longer.

In the beginning of October the writer observed again COMET 1927 *d* (STEARNS) as a small round coma with hardly any condensation; it was near the limit of visibility in the 40-inch refractor.

The search for PERIODIC COMET METCALF 1906 VI, for which an ephemeris is found on p. 476 of last month's issue, has not yet been successful but it should be continued in November.

In the *Russian Astronomical Journal*, Vol. 6, No. 1 (1928), B. Vorontsov-Velyaminov discusses the types of tails and variation of brightness in several recently observed telescopic comets. He emphasizes the importance of carefully noting the physical appearances in faint comets, especially by making long exposures with photographic instruments. He hopes that through the study of the tails originating in faint comets much will be learned concerning their source and development.

In connection with the study of cometary tails a further contribution should be mentioned. F. Gondolatch (*Mitt. Rechen Institut, Berlin-Dahlem*, Vol. 2, No. 6, 1929) has computed the motion in space of tail particles without making the assumption that these particles move in the orbital plane of the comet. This

assumption has been made quite generally in order to simplify the very laborious computations. In the special case of Halley's comet a considerable deviation from the orbital plane is found with the result that the value of the repulsive force of the sun on the tail particles comes out much larger than in the case of the simplified assumption. The author warns against the use in statistical researches of the value of the repulsive force of the sun's light as it results from the simplifying hypothesis.

Williams Bay, Wisconsin, October 24, 1929.

METEOR NOTES.

By CHARLES P. OLIVIER.

Despite the large number of reports published in the last Meteor Notes, which referred to the Perseids, several more have since come in, and there is reason to expect a few additional ones. They confirm the opinion expressed last month that the Perseids returned in average richness. The reports, herein included, for September seem to show a scarcity of meteors. But again we may expect data from other members, which may well reverse this verdict.

Only a fraction of the radiants for 1929 has been worked up so only those few now ready will be included in this paper. However, McIntosh, who deduces his own work very skilfully, sends in a long list, mostly of much needed southern radiants. He was especially successful in observing the Eta Aquarids; the stream connected with Halley's Comet. He obtained good radiants for this stream on May 2, 5, 6, 7, and 11, based upon 18, 19, 5, 24, 10, and 21 meteors respectively. The radiants show a drift of 9° eastward in this interval, thus fully confirming similar observations by the writer published in 1910 and 1911, as well as in later years. This good success over an interval of ten nights shows that the Eta Aquarids should be classed among the most important annual showers. The low altitude of their radiant, coupled with early dawn, is the only reason observers in the Northern Hemisphere have seen them comparatively seldom.

Interesting observations were again made by Dr. H. L. Alden, at the Yale Observatory, Johannesburg, South Africa. As this has a latitude of —26°, even when on the meridian the Perseid radiant (assuming a declination of +56°) has an altitude of only 8°. On August 9, out of 31 meteors there were 5 Perseids, of magnitude 2 to 4. On August 10, out of 23 meteors, 2 certainly were and 2 possibly were Perseids. The former 7 were plotted and their paths average from 20° to 35° long. He also had two cameras, of the type proper for the work, exposed for meteors on both nights. No trails were found on these plates, although he states that 2 meteors crossed their fields.

Another observer, R. C. Shinkfield, at Adelaide, South Australia, sends in his first meteor maps, although other observations on meteors had been previously received from him. He secured an excellent radiant for the Delta Aquarids on July 29, and another on July 30, but based on fewer meteors. Thanks to recent work the radiants south of the celestial equator are beginning to be known. Also the mistakes made by many nineteenth century meteor observers in reducing their work are being avoided by our members. Hence progress will be far more rapid than it was during the past century for northern radiants.

A further important contribution comes from the Lamont-Hussey Observatory, Bloemfontein, South Africa. This consists of a list of 30 completely observed telescopic meteors by Dr. H. F. Donner, and a similar list of 37 telescopic meteors by Dr. H. F. Jessup. As all these were seen within less than one year's time, they form the most extensive single contribution so far received, made with a great telescope. The observers completely filled in all the columns on the regulation "Telescopic Meteors" sheet, so the observations are doubly valuable. Professor B. H. Dawson at National Observatory, La Plata, Argentina, sent in a list of 6 fully observed telescopic meteors, seen late in 1928.

The writer finds it impossible to deduce the radiants from all reports promptly. But each contributor is assured that his radiants will eventually appear. Meantime an effort is being made to publish at once the data from all reports, as they appear herein. The maxima of both Orionids and Leonids in 1929 fall very near full moon. Last year many bright Leonids, as well as several fireballs, were seen. So it is hoped that our members will observe if possible from November 13 to 16. The maximum will probably come on the night of November 15, after midnight. Results last year were so encouraging that many may be seen despite bright moonlight. The Orionids average fainter than the Leonids, unfortunately, so the same remark cannot truthfully be made as to them.

R. A. McIntosh, Auckland, New Zealand.

1929		Began	Ended	Total	Meteors	F	Rate	Cor.Rate	Notes
May	3	3:00	5:30	150	36	0.5	14.4	28.8	
	4	2:40	4:00	55	8		8.7		
	6	2:30	5:30	180	52	0.8	17.3	21.6	
	7	2:30	3:40	70	13	0.6	11.1	18.5	
	8	2:30	5:30	155	57	1.0	22.1	22.1	
	9	2:37	5:40	148	46	0.9	18.6	20.7	
	10	2:50	3:05		6				
	11	2:20	3:40	60	12	0.6	12.0	20.0	
	12	0:25	5:40	315	80	1.0	15.2	15.2	
	13	2:25	2:50		5				
					315				
June	1	11:52	13:10	78	14	0.9	10.8	12.0	3 more
	9	1:10	3:30	140	27	1.0	11.6	11.6	
					41				
July	3	2:48	5:08	140	27	0.8	11.6	14.5	2 more
	4	2:45	4:45	120	25	1.0	12.5	12.5	
	5	2.45	5:30	165	36	1.0	13.1	13.1	
	6	2:30	4:30	105	26	0.9	14.9	16.6	
	9	2:45	4:00	50	19	1.0	22.8	22.8	
	11	3:05	4:50	105	31	0.9	17.7	19.7	4 more
					164				

Carl P. Schafer, Nashville, Tenn.

1929		Began	Ended	Total	Meteors	F	Rate	Cor.Rate	Notes
Sept.	17	12:40	13:40	60	2	1.0	2.0	2.0	
	21	7:15	11:30	120	4		2.0		
	26	11:00	13:00	120	7	1.0	3.5	3.5	
	27	13:00	14:00	60	8	1.0	8.0	8.0	
	29	10:50	11:30	40	5	0.9	7.5	8.4	
Oct.	1	12:25	14:00	95	13	1.0	8.2	8.2	
	2	13:00	14:00	60	7	1.0	7.0	7.0	
					46				all plotted

DR. H. L. ALDEN, JOHANNESBURG, SOUTH AFRICA.

1929	Began	Ended	Total	Meteors	F	Rate	Cor.Rate	Notes
Aug. 9	14:53	17:42	171	31	0.8	10.9	13.6	5 Perseids
10	15:00	17:30	150	23	1.0	9.2	9.2	2 Perseids, 2?
				54				30 plotted

LATIMER J. WILSON, FRANKLIN, KENTUCKY.

1929	Began	Ended	Total	Meteors	F	Rate	Cor.Rate	Notes
Aug. 12	12:21	14:17	116	29	1.0	15.0	15.0	
14	12:01	13:05	64	5	1.0	4.7	4.7	
				34				all plotted

VINCENT ANYZESKI, NEW HAVEN, CONN.

1929	Began	Ended	Total	Meteors	F	Rate	Cor.Rate	Notes
June 29	8:30	12:00	210	62	1.0	17.7	17.7	
July 30	9:30	11:40	130	23	0.9	10.6	11.8	
Aug. 2	9:25	12:30	185	55	1.0	17.8	17.8	
				140				all plotted

B. C. DARLING, LANSING, MICHIGAN.

1929	Began	Ended	Total	Meteors	F	Rate	Cor.Rate	Notes
April 21	8:57	15:25		24	0.4			Moon nearly full
22	9:23	13:40	242	8	0.4	2.0	5.0	Moon full
26	9:20	11:20	88	3		2.0		
May 4	14:45	16:27	102	7	0.8	4.1	5.1	5 η Aquarids
5	14:14	16:30	136	8	0.8	3.5	4.4	4 η Aquarids
6	13:35	16:20	165	8	1.0	2.9	2.9	2 η Aquarids
7	10:28	13:17	127	3	0.9	1.4	1.6	
19	14:13	15:57	104	5	0.9	2.9	3.2	
26	12:00	12:50	50	3	0.7	3.6	5.1	
29	9:55	11:44	149	5	1.0	2.0	2.0	
30	9:40	12:53	193	7	1.0	2.2	2.2	
31	9:53	12:20	147	12	1.0	4.9	4.9	
	12:32	15:01	149	12	0.6	4.8	8.0	from window
June 1	11:09	12:53	102	3	1.0	1.8	1.8	
2	9:50	11:04	59	0	0.9	0.0	0.0	
	13:32	15:32	120	3	0.7	1.5	2.1	
5	9:30	10:30	60	4	0.9	4.0	4.4	
6	9:37	10:45	68	2	0.7	1.8	2.6	
7	9:50	12:55	167	6	1.0	2.2	2.2	
10	10:03	12:26	133	4	1.0	1.8	1.8	
14	10:35	11:52	77	2	0.7	1.6	2.3	
15	11:40	15:29	229	15	0.8	3.9	4.9	
Aug. 21	9:05	10:55	75	0	0.7	0.0	0.0	
23	9:19	10:19	60	8	0.9	8.0	8.9	
23	12:02	13:02	60	1	0.7	1.0	1.4	
24	8:35	11:00	69	3	1.0	2.9	2.9	
25	8:28	11:40	180	10	0.8	3.3	4.1	2 more, Mrs. B.F.D.
27	9:51	12:55	136	10	1.0	4.4	4.4	
28	10:05	10:36	31	3	0.7	5.8	8.3	
29	8:55	12:10	195	15	1.0	4.6	4.6	
31	9:51	12:01	93	4	0.5	2.6	5.4	
Sept. 1	8:52	9:55	63	2	1.0	1.9	1.9	
2	9:01	9:46	45	2	1.0	2.7	2.7	
3	10:15	10:41	26	2	1.0	4.7	4.7	1 more, Mrs. B.F.D.
				60				

A. S. Lawrence, Merrick, L. I., N. Y.

1929	Began	Ended	Total	Meteors	F	Rate	Cor.Rate
Sept. 3	13:00	16:00	180	9	1.0	3.0	3.0

F. C. W. Olsen, Landsvägsgaten, Sweden.

1929	Began	Ended	Total	Meteors	F	Rate	Cor.Rate
Aug. 6	11:20	13:00	100	21		12.6	
7	10:40	12:15	95	20	0.6	12.7	21.2
—				4			
31	11:45	12:55	70	13		11.1	
				—			
				58			

Millard Bennett, Fort Wayne, Indiana.

1929	Began	Ended	Total	Meteors	F	Rate	Cor.Rate
Sept. 27	8:36	10:16	100	8	0.7	4.8	6.9

Mrs. Willis L. Smith, Detroit, Michigan.

1929	Began	Ended	Total	Meteors	F	Rate	Cor.Rate	Notes
Aug. 11	12:15	13:50	95	14				counts and descriptions

R. C. Shinkfield, Adelaide, S. Australia.

1929	Began	Ended	Total	Meteors	F	Rate	Cor.Rate	Notes
July 28	14:00	15:30	90	14	1.0	9.3	9.3	
29	11:00	12:15	75	28	1.0	22.4	22.4	
30	11:00	12:00	60	25	1.0	25.0	25.0	
				—				
				67				15 plotted

Miss Alice J. Anderson, Ramona, California.

1929	Began	Ended	Total	Meteors	F	Rate	Cor.Rate
Aug. 11	11:00	12:05	65	18	0.9	16.7	18.6

Radiants by H. L. Alden.

Date		α	δ	Meteors	Wt.
1929 Aug.	9	4	+11	4-5	g
	9	25	+15	4	f
	10	4.6	+ 8.5	3	f
	10	27	+15	3	g

Radiants by R. C. Shinkfield.

Date		α	δ	Meteors	Wt.	Notes
1929 July	29	341.9	—16.8	6	g	Delta Aquarids
	30	339	—18	3	f	Delta Aquarids
	30	330	—42	3	f	

Radiants by R. A. McIntosh.

No.	1929 May G.M.T.	α	δ	Meteors	Wt.	Remarks
144	2.70	272°5	—35°0	8	Ex.	See 149, 160, 167, 171 1 meteor on May 3. D. 210, 3, Apl. 25; 273° — 30°. D. 120, 4, May 26+, 278° — 35°.
145	2.70	334.0	— 1.5	18	Ex.	Eta Aquarids. Diffuse, 5°×5°. See 152, 153, 159, 165, 175. AMS. 166, May 4, 334° — 3°4; BAA. May 2, 335° — 2°; AMS. 183.
146	2-3c.	313.0	—42.0	5	Good	Mic. See 151. 3 meteors May 2, 2 meteors May 3.
147	2-3c.	326.0	—17.5	3	Fair	δ Cap. See 150. Comet 837 I, May 1, 334° — 16°.
148	5.69	257.0	± 0.0	3	Fair	D. 193, 1; Apl. 27, 256° — 2°.

No.	1929 May	G.M.T.	α	δ	Meteors	Wt.	Remarks
149	5.69		272.0	—27.3	8	Good	See 144, 160, 167, 171.
150	5.69		326.0	—17.5	6	Good	δ Cap. See 147. 1 meteor May 6.
151	5.69		327.4	—35.0	6	Good	See 146?, 164, 1 meteor May 6.
152	5.69		337.5	— 1.0	19	Ex.	η Aquarids. See 145, 153, 159, 165, 175.
153	6.65		338.6	± 0.0	5	Fair	η Aquarids. Poor in declination. See 145, 152, 159, 165, 175.
154	7.69		249.0	—15.0	4	Fair	D. 190, 3; May 12-14, 248°—15°; D. 190, 2, April 30-May 7, 254° — 21°.
155	7.69		271.0	—10.0	3	Fair	
156	7.69		302.5	—12.5	7	Good	See 161, 173. D. 237, 2, May 1-4, 309° — 17°; 237, 3, May 26+, 305° — 10°.
157	7.69		307.0	+14.0	3	Fair	See 162, 174. Comet 1853 II, May 1, 296°.5 + 13°.5; D. 243, 1, May 13-16, 314° + 15°.
158	7.69		308.0	—48.0	6	Good	See 163.
159	7.69		339.0	— 0.4	24	Ex.	η Aquarids. See 145, 152, 153, 165, 175.
160	8.69		273.0	—32.0	3	Poor	See 144, 149, 167, 171. D. 210, 3, April 25, 273°.— 30°; D. 210, 4, May 26+, 278° — 35°.
161	8.69		302.5	—15.0	9	Ex.	See 156, 173. 1 St. meteor.
162	8.69		307.5	+14.5	4	Good	See 157, 174.
163	8.69		308.0	—49.0	6	Good	See 158.
164	8.69		325.0	—36.0	2	Poor	Confirms 151.
165	8.69		339.0	+ 0.3	10	Ex.	η Aquarids. See 145, 152, 153, 159, 175.
166	9-10c.		245.0	—60.0	3	Fair	BAA. 163, May 3, 251° — 61°.
167	9-10c.		275.0	—32.5	3	Fair	See 144, 149, 160, 171.
168	9-10c.		300.0	—26.0	3	Fair	See 172.
169	11.69		237.5	+ 1.0	4	Poor	D. 177, 9, May 9, 234° + 9°; D. 187, 6, May 31, 240° + 4°.
170	11.69		242.0	—30.5	9/10	V. G.	A well-known shower near this on May 15-17. See M. 12, 1926, May 15, 249°.5 — 25°.0.
171	11.69		275.0	—28.0	3	Poor	See 144, 149, 160, 167.
172	11.69		301.0	—24.5	8	Good	See 168.
173	11.69		302.0	—15.0	7	Fair	α Cap. See 156, 161.
174	11.69		307.7	+14.0	7	V. G.	See 157, 162.
175	11.69		342.7	+ 2.5	21	Ex.	η Apr. See 145, 152, 153, 159, 165.

No.	1929 June	G.M.T.	R.A.	Dec.	Meteors	Wt.	Remarks
176	1.54		286°.5	—38°.0	4	Fair	Possibly a poor plot of 177.(?)
177	8.62		277.0	—35.0	9	Good	
178	8.62		296.0	+ 1.0	4	Fair	
179	8.62		327.0	+ 0.5	3	Good	
—(a)	1.54		300.	—21.	4	?	Uncertain
—(b)	8.62		272.	—12.	2	?	Uncertain
—(c)	8.62		341.	—41.	4	?	Uncertain. Indeterminate in R.A. Good in Dec.

COMPARISON WITH OTHER RADIANTS.

177. D. 210, 4, May 26-June 13, 278° — 35°.
178. D. 230, 7, June 7-Aug., 294° + 3°. D. 230, 8, June 29, 295° + 1°. AMS., 1069, June 14, 294° + 6°.
179. D. 251, 1, June 26-July 11, 325° + 3°. D. 260, 1, May 26-June 13, 332° ± 0°.

—(b) D. 204, 2, June, 269° — 11°. D. 204, 3, June, 266° — 12°. AMS., 1040, June 15, 278° — 8°.
—(c) See McIntosh No. 37, June 22, 1928, at 345°.7 — 43°.7.

No.	1929 G.M.T. July	R.A.	Dec.	Meteors	Wt.	Remarks
180	2.69	10°.0	+ 5°.0	8	Poor	5 meteors July 2, 1 meteor July 3, 2 meteors July 4. See D. 2, 1. Comet 1864 II, June 27, 12° + 6°.
181	2.69	310.5	—13.0	3	Fair	See 186.
182	2.69	334.0	—30.0	8	Good	See 187, 191.
183	2.69	348.5	— 9.5	5	Good	See 188, 192, 195, 196.
184	2.69	353.0	+25.0	5	Poor	3 meteors July 2, ?1 on July 4, 2 on July 5. D. 5, 1. D. 274, 1.
185	3.68	286.0	—28.0	6	Fair	2 meteors July 2, 3 on July 3, 1 on July 4.
186	3.68	310.5	—14.0	4	Fair	See 181.
187	3.68	334.0	—31.0	5	Good	See 182, 191.
188	3.68	248.5	— 9.0	4	Good	See 183, 192, 195, 196.
189	2-3	326.0	—22.0	4	Good	2 meteors July 2, 1 on July 3, 1 on July 5. ?D. 252, 6.
190	4.69	316.0	—36.0	7	Fair	2 meteors July 2, 3 on July 4, 2 on July 5.
191	4.69	334.0	—32.0	5	Fair	See 182, 187.
192	4.69	348.5	— 9.0	10	Ex.	See 183, 188, 195, 196.
193	5.67	290.0	— 9.0	6	Fair	2 meteors July 3, 4 on July 5.
194	5.67	301.0	— 7.5	4	Fair	
195	5.67	350.0	— 9.0	4	Fair	See 183, 188, 192, 196.
196	8.66	348.5	— 8.0	5	Good	See 183, 188, 192, 195.
197	10.69	37.5	+ 4.7	5	Fair	D. 26, 1.
198	10.69	302.0	—15.0	6	Fair	BAA. 9th Memoir, July, 304° — 12°. D. 237, 8; 237, 11.
199	10.69	351.0	—41.0	5	Good	D. 275, 1, July, 354° — 46°.
—	2-4	305	—25	4	?	2 meteors July 2, 2 on July 4. Uncertain.
—	4-5	65	+ 3	3	Poor	1 meteor on July 4, 2 on July 5 Uncertain.
—	8 & 10	312	—34	4	Poor	2 meteors July 8, 2 on July 10. See 190. Uncertain.
—	10.69	10	+ 7	3	Poor	1 meteor July 8, 2 on July 10. See 180. Uncertain.
—	10.69	18	—45	3	Poor	1 meteor July 8, 2 on July 10. Uncertain.
—	10.69	319	+ 7	3	Poor	Meteors close to Radiant. 1 meteor on July 5.

NOTE: A letter from Professor C. C. Wylie clears up why his results and my own differ for the end point of the great Illinois fireball of July 25. His point is that at which the main explosion took place, that referred to by me (and farther north) is where the red fragments were last seen. Possible meteorites should therefore be sought near the latter.

Flower Observatory, Upper Darby, Pennsylvania, 1929 October 10.

Fireballs Reported to the University of Iowa.

Six bright meteors, or fireballs, were reported to the Department of Astronomy of the University of Iowa from June 25, 1929, to September 25, 1929, inclusive. Articles on the meteors of June 25 and July 25 appear elsewhere in this issue of POPULAR ASTRONOMY.

The third bright meteor fell on the evening of August 14, and was reported by Mr. Carl H. Fischer, a graduate student in our Department of Mathematics. It was brighter than Venus at greatest brilliancy, and probably in reality over southern Wisconsin, although we did not get enough information to justify a computation of its path.

The fourth fell at about 8:15 P.M. on the evening of September 16. It was reported by some residents of Iowa City, Iowa; and independently by Mr. Wm. W. Davidson of Burlington. We hope to have enough information for a computation of its path.

The next was evidently a very brilliant meteor seen over Ontario and western New York. It was reported that this meteor "bathed the entire Lake Shore district west of Toronto in the glare of a bursting meteor at 8:00 o'clock last night" (September 24). "A report from Lockport said the light from the meteor was so brilliant that for a few seconds the city seemed bright as day." These quotations are from the *Toronto Globe* of September 25.

The last of these bright meteors fell at about 9:15 P.M. on the evening of September 25, and was reported first by Professor Ralph C. Huffer of Beloit College. An independent report, presumably on the same meteor, was received from T. J. Barnes at Bussey, Iowa. We hope to secure additional information on this meteor.

C. C. WYLIE.

VARIABLE STARS.

Monthly Report of the American Association of Variable Star Observers, for the Month of September, 1929.

Sig. Salvatore Taffara, assistant at the Royal Observatory at Catania, Italy, submits his first report and also applies for active membership in the Association. We are pleased to welcome another contributor from Italy, where under ideal observing conditions, the interest in astronomy, especially in the study of variable stars, appears to be steadily on the increase. Sig. Lacchini, our veteran observer in that same clime, renders the prize report of the season, numbering almost 600 observations; not only valuable from the standpoint of quantity, but also quality.

R Scuti passed through a minimum, magnitude 7.8, about September 1. This is the faintest minimum observed since October, 1927, when the variable reached 8.1. The peculiar actions of this variable, so recently thoroughly discussed by Dr. Gerasimovič, warrants our closest attention. R Cor. Bor. has been at practically constant maximum brightness, around 6.0, for more than five years. This star also demands our closest attention in order that the first sign of a decrease to minimum may be noted without fail. SU Tauri is back to normal again, and S Apodis is slowly nearing that same phase. SS Cygni was rising to maximum at last accounts, the increasing branch of the light curve having been well observed during September.

VARIABLE STAR OBSERVATIONS RECEIVED DURING SEPTEMBER, 1929.

July 0 = J.D. 2425793; Aug. 0 = J.D. 2425824; Sept. 0 = J.D. 2425855.

J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.
V SCL	S CET	W CAS	U PER	S PER	U ARI
000339	*001909*	004958	015254	021558	030514
819 9.4 Dr	825[11.5 Ch	870 10.0 BL	827 10.4 Ah	828 9.5 Ah	847 9.4 L
822 9.6 Bl	828[14.0 L	873 9.8 BL	830 10.5 Ah	830 9.5 Ah	X CET
S SCL	837 14.5 L	U TUC	839 10.4 Pt	839 9.7 Pt	*031401*
001032	855[13.5 L	*005475*	R ARI	849 10.0 Jo	828 10.8 L
819 10.1 Dr	T SCL	822 13.0 Bl	021024	851 9.4 Ah	838 11.3 L
822 10.6 Bl	*002438a*	Z CET	827 9.0 Ah	852 9.5 Ah	839 10.7 Pt
839 10.0 Pt	819 9.2 Dr	*010102*	830 9.1 Ah	866 9.7 Jo	847 11.3 L
X AND	T PHE	828 11.8 L	837 10.0 Ah	873 9.4 BL	Y PER
001046	*002546*	837 12.7 L	838 10.0 Ah	R CET	032043
827 10.2 Lj	819 10.7 Dr	839 12.6 Pt	839 10.0 Pt	*022000*	839 8.9 Pt
830 10.5 Lj	822 10.6 Bl	855 13.2 L	839 10.0 Gb	828 8.3 L	839 9.5 Gb
841 10.7 Lj	W SCL	U SCL	839 10.4 Fd	837 7.9 L	R PER
848 11.0 Lj	*002833*	*010630*	840 10.3 Fd	847 7.8 L	032335
850 11.3 Lj	822 13.1 Bl	822 11.8 Bl	840 10.1 Ah	849 8.3 Jo	828 9.3 L
854 11.7 Lj	Y CEP	U AND	842 10.5 Fd	866 7.9 Jo	838 9.6 L
859 11.3 Br	003179	010940	843 10.4 Fd	RR PER	839 9.6 Pt
T CET	825 9.4 Ch	829[13.0 L	851 11.0 Fd	022150	847 9.9 L
001620	832 9.4 L	UZ AND	852 10.8 Fd	828 9.8 L	T FOR
828 6.6 L	845 9.3 L	011041	853 10.9 Fd	838 9.0 L	*032528*
835 6.5 L	849 10.1 Sf	855[14.5 L	854 10.8 Fd	839 9.1 Pt	827 9.4 L
837 6.5 Tf	858 10.2 Sf	S PSC	856 11.2 Fd	847 9.3 L	837 9.3 L
851 6.3 Tf	859 10.0 Br	011208	W AND	R FOR	842 9.4 L
854 6.6 L	866 10.7 Sf	828 13.0 L	021143a	*022426*	854 9.1 L
855 6.5 An	U CAS	837 13.3 L	827 10.8 Ah	822 11.6 Bl	R TAU
T AND	004047	855 13.8 L	839 10.9 Pt	U CET	042209
001726	832 9.5 L	S CAS	T PER	*022813*	839 9.5 Pt
839 8.6 Pt	839 9.9 Pt	011272	021258	839 12.0 Pt	W TAU
839 9.1 Ch	845 10.7 L	825[11.9 Ch	828 8.7 Ah	RR CEP	042215
849 9.5 Jo	859 11.2 Br	852[14.3 Br	830 8.6 Ah	022980	839 10.6 Pt
858 9.8 Jo	RW AND	855[13.6 L	839 8.4 Pt	825[11.6 Ch	858 11.0 Jo
866 9.8 Jo	004132	U PSC	849 9.8 Jo	832[14.0 L	866 10.6 Jo
T CAS	828 10.7 L	011712	851 8.8 Ah	855[14.0 L	S TAU
001755	837 9.7 L	855 12.6 L	852 8.8 Ah	R TRI	042309
827 9.0 Ch	839 9.1 Pt	RZ PER	858 10.0 Jo	023133	839 11.7 Pt
832 8.8 L	845 8.5 L	012350	Z CEP	827 10.0 Ah	T CAM
839 8.5 Pt	859 8.0 Br	832 13.7 L	021281	830 10.1 Ah	043065
842 8.6 L	V AND	855 13.6 L	852[13.8 Br	837 10.4 Ah	829 8.1 L
848 8.4 Jo	004435	RU AND	o CET	838 10.4 Ah	838 8.0 L
855 8.5 L	859[13.6 Br	013238	*021403*	839 10.6 Pt	839 7.8 Pt
858 8.5 Jo	X SCL	826 12.5 L	828 4.5 L	840 10.5 Ah	RX TAU
866 7.7 Jo	*004435*	837 12.4 L	832 4.7 L	851 11.2 Ah	043208
R AND	822 13.0 Bl	839 13.5 Pt	837 5.2 L	W PER	828 12.1 L
001838	RR AND	858 11.7 L	837 5.1 Tf	024356	838 11.6 L
837 11.3 Ah	004533	Y AND	838 5.1 Ah	839 8.7 Pt	847 11.3 L
839 12.0 Fd	828[13.3 L	013338	839 5.3 Pt	858 9.2 Jo	R RET
849 11.0 Jo	859[13.9 Br	828 10.7 L	845 5.1 Tf	866 9.0 Jo	*043263*
851 11.7 Ah	RV CAS	837 9.8 L	845 5.2 L	R HOR	796 7.6 Bl
853 12.3 Fd	004746a	838 9.9 Ch	848 6.7 Jo	*025050*	814 7.5 Bl
858 12.0 Jo	832 14.7 L	839 9.6 Pt	851 5.2 Tf	822 11.0 Bl	822 8.0 Bl
859 13.3 Br	W CAS	858 9.4 L	856 5.7 BL	T HOR	X CAM
866[12.0 Jo	004958	X CAS	858 6.5 Jo	*025751*	043274
S TUC	839 10.7 Pt	014958	858 6.0 L	822 11.6 Bl	829 7.9 L
001862	848 9.9 Jo	839 11.6 Pt	863 5.9 BL	U ARI	838 8.3 L
814 9.5 Bl	858 9.5 Jo	850 11.9 Bn	866 6.0 Jo	030514	839 7.9 Pt
819 10.0 Dr	858 10.0 BL	858 12.0 Bn	866 6.8 Gy	828 8.9 L	R DOR
822 9.8 Bl	865 10.1 BL	866 12.0 Bn	869 5.9 BL	838 9.2 L	*043562*
	866 8.9 Jo				796 5.5 Bl

VARIABLE STAR OBSERVATIONS RECEIVED DURING SEPTEMBER, 1929.

J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.
R DOR	T ORI	SU TAU	AG AUR	R CMI	Y VEL
043562	*053005a*	054319	062047	070310	*092551*
814 5.5 Bl	837 11.4 L	846 9.7 L	845 9.2 L	841 7.7 L	794 9.7 En
822 5.5 Bl	838 10.9 L	847 9.6 L	R MON	854 7.7 L	796 9.3 Bl
R CAE	839 10.7 L	849 9.6 L	063308	R VOL	799 9.8 Ht
043738	840 11.3 Pt	850 9.7 L	866 11.7 Pt	*070772*	814 10.1 Bl
822 8.4 Bl	841 11.0 L	851 9.7 L	NOV PIC	794 13.0 En	820 10.2 Bl
R PIC	842 10.8 L	854 9.6 L	*063462*	799 12.2 Ht	820 10.2 Ht
044349	843 11.1 L	Z TAU	704 7.7 En	820 12.8 Ht	821 10.1 Sm
822 7.5 Bl	844 11.2 L	054615a	799 7.8 Ht	821 13.4 Sm	825 10.6 Dr
R ORI	845 10.8 L	838 13.8 L	S LYN	L_2 PUP	R CAR
045307	846 10.7 L	854 13.5 L	063558	*071044*	*092962*
828 11.8 L	847 10.4 L	RU TAU	829[13.0 L	819 3.1 Dr	794 9.6 En
838 12.0 L	849 10.4 L	054615c	838[13.8 L	V GEM	796 9.5 Bl
847 11.8 L	850 10.3 L	838 12.1 L	854 13.8 L	071713	799 9.9 Ht
R LEP	851 10.3 L	854 11.9 L	X GEM	854 9.3 L	814 9.6 Bl
045514	853 10.2 L	α ORI	064030	S VOL	819 10.0 En
827 7.3 L	854 10.2 L	054907	862 8.7 Bn	*073173*	820 9.6 Bl
837 7.2 L	AN ORI	847 0.5 L	W MON	794 11.6 En	820 9.9 Ht
839 6.8 Pt	*053005f*	U ORI	*064707*	796 12.0 Bl	821 10.0 Sm
847 7.0 L	832 11.6 L	054920a	866 9.2 Pt	799 11.7 Ht	825 9.8 Dr
849 7.2 Jo	833 11.8 L	839 11.2 Pt	Y MON	814 12.0 Bl	Y DRA
866 6.9 Jo	836 11.7 L	849 10.5 Jo	065111	820 12.4 Bl	093178
V ORI	837 11.8 L	866 9.9 Jo	838 11.8 L	820 12.2 Ht	829[13.0 L
050003	838 11.6 L	Z AUR	866 10.0 Pt	825 12.8 Dr	851[13.9 L
832 13.2 L	839 11.5 L	055353	X MON	U CMI	RR HYA
839 12.7 Pt	841 11.6 L	.839 10.4 Pt	*065208*	073508	*094023*
854 13.6 L	842 11.6 L	840 10.3 Pt	847 11.9 L	842 9.6 L	795 9.7 En
S PIC	843 11.7 L	855 11.5 Pt	R LYN	W PUP	825 10.5 Dr
050848	844 11.7 L	856 11.5 Pt	065355	*074241*	Y HYA
822[12.2 Bl	845 11.6 L	864 11.5 Pt	827 8.9 Ah	795 8.9 En	*094622*
R AUR	846 11.6 L	R OCT	829 8.3 L	796 8.7 Bl	795 7.5 En
050953	847 11.6 L	*055686*	830 8.7 Ah	799 8.7 Ht	Z VEL
827 10.0 Ah	849 11.6 L	796 9.6 Bl	831 8.6 Ah	814 8.2 Bl	*094953*
830 10.3 Ah	851 11.6 L	814 9.8 Bl	837 8.5 Ah	R CHA	796 12.6 Bl
839 11.0 Pt	S CAM	819 9.9 Dr	838 8.4 Ah	*082476*	799 12.3 Ht
T PIC	053068	820 9.7 Bl	839 8.0 L	794[12.4 Ch	814 11.9 Bl
051247	827 10.0 Ah	820 10.1 Ht	840 8.4 Ah	799[12.4 Ht	820 11.7 Bl
822 8.0 Bl	830 10.0 Ah	830 10.0 Dr	847 8.0 Ah	818[12.6 Bl	820 12.3 Ht
NOV TAU	839 10.0 Pt	X AUR	848 7.9 Ah	820[12.4 Ht	821 12.8 Sm
051316	RU AUR	060450	850 8.0 Ah	821[12.4 Sm	825 12.2 Dr
832 13.7 L	053337	826 12.3 Lj	851 8.2 Ah	V UMA	RR CAR
S AUR	839[12.0 Pt	829 11.8 Lj	852 8.2 Ah	090151	*095458*
052034	SU TAU	839 11.6 Pt	854 7.7 L	831 10.9 L	794 8.1 En
839 8.0 Pt	054319	841 11.3 Lj	855 8.3 Ah	842 10.2 L	RV CAR
W AUR	825 9.5 L	848 10.4 Lj	856 8.3 Ah	RX UMA	*095563*
052036	827 9.7 L	851 10.3 Lj	V CMI	090567	794[12.5 En
832 13.2 L	829 9.7 L	854 10.3 Lj	070109	829 10.7 L	818[13.1 Bl
839 12.5 Pt	831 9.6 L	V AUR	841 8.9 L	843 10.6 L	824 14.7 Dw
842 12.3 L	833 9.8 L	061647	854 8.4 L	RW CAR	824 14.8 Dr
S ORI	835 9.5 L	828 8.7 L	R GEM	*091868*	S CAR
052404	836 9.5 L	835 9.2 L	070122a	794 11.6 En	*100661*
839 9.1 Pt	837 9.6 L	845 9.2 L	866 13.0 Pt	796 11.1 Bl	794 5.8 En
T ORI	838 9.8 L	V MON	Z GEM	799 10.1 Ht	796 5.0 Bl
053005a	839 9.7 L	*061702*	070122b	814 9.6 Bl	799 5.8 Ht
827 11.2 L	841 9.7 L	866 6.2 Pt	866 12.4 Pt	820 9.4 Bl	814 4.5 Bl
831 11.4 L	842 9.7 L	AG AUR	TW GEM	820 9.4 Ht	819 5.3 Dr
832 11.4 L	843 9.7 L	062047	070122c	825 9.5 Dr	819 6.0 En
833 11.4 L	844 9.8 L	828 10.1 L	866 8.2 Pt		
836 11.4 L	845 9.7 L	835 9.5 L			

VARIABLE STAR OBSERVATIONS RECEIVED DURING SEPTEMBER, 1929.

J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.
S CAR	RS CEN	T UMA	S UMA	T UMI	Z BOO
100661	*111661*	123160	123961	133273	140113
820 5.8 Ht	818 9.9 En	850 8.8 Ah	852 7.4 Ah	839 10.0 Fd	846 13.0 L
820 5.2 Bl	820 10.1 Ht	851 8.8 Ah	853 7.8 Fd	845 10.0 L	Z VIR
821 6.0 Sm	821 10.1 Sm	851 8.7 Fd	854 8.0 Lj	848 9.7 Jo	*140512*
824 5.2 Dr	824 9.5 Dr	852 8.5 Fd	855 7.5 Ah	849 10.8 Sf	846[12.0 L
830 5.6 Dr	830 8.9 Dr	852 8.9 Ah	856 7.5 Ah	852 10.8 Fd	RU HYA
838 5.9 Dr	X CEN	853 8.6 Fd	856 8.1 Pt	853 10.9 Fd	*140528*
Z CAR	*114441*	855 8.6 Ah	856 7.6 Fd	856 10.9 Fd	795[12.5 En
101058a	797[13.1 Bl	856 8.5 Ah	857 7.7 Ma	856 11.4 BL	819 12.5 En
799[12.6 Ht	818[13.1 Bl	856 8.5 Fd	857 7.8 Wd	857 11.5 BL	819 13.5 Dr
818[12.6 Bl	AD CEN	856 9.0 Pt	858 7.6 Jo	858 11.4 BL	820[13.5 Ht
819[12.3 En	*114858*	857 8.7 Ma	866 8.2 Wd	858 10.7 Jo	R CEN
820[12.6 Ht	794 9.2 En	858 8.6 Jo	866 7.6 Jo	865 11.6 BL	*140959*
821[12.3 Sm	799 9.6 Bl	866 8.5 Jo	871 8.3 Wd	866 11.8 Jo	795 7.8 En
824 15.1 Dw	818 9.3 En	866 8.9 Wd	RU VIR	T CEN	797 7.9 Bl
AF CAR	820 9.3 Bl	RS UMA	124204	*133633*	814 7.9 Bl
101058b	W CEN	123459	831 12.3 L	795 6.5 En	818 7.8 En
830[11.9 Dr	*115058*	848 10.7 Jo	U VIR	797 6.5 Bl	820 8.0 Ht
W VEL	797 12.1 Bl	856 11.3 Pt	124606	814 6.7 Bl	821 7.3 Bl
101153	799 12.2 Ht	858 12.0 Jo	831 12.2 L	818 7.1 Bl	825 7.8 Dr
794 11.1 En	814 10.4 Bl	857 12.1 Ma	U OCT	819 6.9 Dr	835 7.7 Dr
797 10.7 Bl	818 10.7 En	S UMA	*131283*	819 7.1 En	U UMI
799 11.0 Ht	820 10.3 Ht	123961	795 10.3 En	820 6.9 Ht	141567
814 11.0 Bl	820 10.2 Bl	827 8.1 Ah	797 10.3 Bl	821 6.9 Bl	827 8.0 Ah
819 11.7 Dr	825 9.7 Dr	827 8.3 Lj	814 8.3 Bl	825 6.9 Dr	827 8.5 Lj
820 10.9 Bl	SS VIR	828 8.1 Ah	818 9.0 En	830 7.1 Dr	828 8.1 Ah
820 12.0 Ht	122001	829 8.3 Lj	819 8.4 Dr	RT CEN	829 8.4 Lj
821 12.0 Sm	829 7.1 L	829 8.1 An	820 8.6 Ht	*134236*	830 8.1 Ah
830 11.6 Dr	837 7.2 L	830 8.0 Ah	821 8.4 Bl	795 11.4 En	831 8.1 Ah
RZ CAR	846 6.5 L	831 7.8 Gt	825 8.4 Dr	797 12.0 Bl	837 7.9 Ah
103270	T CVN	831 8.0 Ah	838 8.3 Dr	819 12.2 Dr	837 8.4 Lj
794[12.4 En	122532	837 8.0 Ah	V VIR	819 12.0 En	838 8.0 Ah
818[12.4 En	856 10.5 Pt	837 8.0 Lj	*132202*	820 11.7 Ht	840 8.0 Ah
R UMA	U CEN	838 7.9 Ah	831[13.4 L	820 12.9 Bl	840 8.5 Lj
103769	*122854*	839 8.0 Fd	R HYA	R CVN	846 8.5 Ah
856 12.8 Pt	797 11.0 Bl	840 7.9 Fd	*132422*	134440	847 8.3 Ah
V HYA	806 10.1 En	840 8.0 Lj	795 9.0 En	827 9.5 Ah	847 8.5 Lj
104620	814 9.2 Bl	840 7.7 Gt	797 9.3 Bl	830 9.4 Ah	848 8.5 Lj
796 7.5 Bl	818 9.1 En	840 7.6 An	814 8.4 Bl	837 9.6 Ah	848 8.7 Ah
814 7.3 Bl	821 8.7 Bl	840 7.7 Ah	818 8.7 En	851 10.2 Ah	849 8.5 Jo
820 7.0 Bl	824 8.7 Dr	842 7.8 Fd	820 8.8 Ht	856 10.2 Ah	850 8.7 Ah
RS HYA	830 8.4 Dr	843 7.7 Fd	821 8.3 Bl	856 10.2 Pt	850 8.7 Lj
104628	T UMA	844 8.0 Ch	S VIR	856 10.4 BL	851 8.7 Ah
796 12.7 Bl	123160	846 7.8 Ah	*132706*	857 10.3 BL	852 8.7 Ah
820[12.5 Bl	827 10.4 Ah	847 8.0 Lj	795 6.7 En	858 10.3 BL	852 8.6 Lj
RS CAR	828 10.4 Ah	847 7.6 Ah	818 8.2 En	RX CEN	855 8.8 Ah
110361	830 10.2 Ah	848 7.5 Ah	820 7.8 Ht	*134536*	856 8.8 Ah
794[12.3 En	831 10.1 Ah	848 7.5 Jo	RV CEN	797 13.5 Bl	856 8.7 Pt
821[12.3 Sm	837 9.8 Ah	848 8.0 Lj	*133155*	819 13.6 Dr	858 8.6 Jo
RY CAR	838 9.7 Ah	849 7.7 Fd	797 8.5 Bl	T APS	866 8.7 Jo
111561	839 9.5 Fd	850 8.0 Lj	806 8.0 En	*134677*	S BOO
796 13.3 Bl	840 9.6 Ah	850 7.6 Gt	814 7.8 Bl	795[13.2 En	141954
818[13.1 Bl	843 9.4 Fd	850 7.7 An	818 7.6 En	819[12.7 En	830 12.5 L
821[12.1 Sm	844 9.2 Ch	850 7.4 Ah	819 8.4 Dr	820[13.2 Bl	831 12.0 Ch
RS CEN	846 9.2 Ah	851 7.7 Ah	821 7.5 Bl	830 14.7 Dw	833 12.3 An
111661	847 9.2 Ah	851 7.8 Fd	T UMI	830 14.8 Dr	833 12.3 Gt
797 12.5 Bl	848 9.0 Ah	852 7.7 Fd	133273	Z BOO	844 12.9 Gt
799 12.5 Ht	848 8.8 Jo		829 9.3 L	140113	844 11.9 An
818 9.9 Bl	849 9.0 Fd		837 9.5 L	829 13.4 L	846 13.2 L

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J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.
S Boo	S Aps	RU Lib	U Lib	R CrB	R Ser
141954	*145971*	*152714*	*153620a*	154428	154615
852 11.9 An	797 12.0 Bl	829 11.9 An	820[13.1 Bl	846 6.0 L	831[12.1 Ch
852 12.7 Gt	798 11.2 En	829 11.8 L	T Nor	847 6.2 An	V CrB
856 13.6 Pt	803 11.2 En	837 11.7 L	*153654*	847 6.2 Lj	154639
RS Vir	814 11.5 Bl	844 11.4 An	797 12.8 En	847 5.6 Lg	828 7.5 Ah
142205	818 11.0 En	844 11.2 Gt	825 13.3 Dr	848 6.1 Pt	856 6.5 Pt
829[13.7 L	819 11.2 Dr	846 12.8 L	Z Lib	848 6.0 Jo	858 7.9 BL
846[13.2 L	820 11.6 Bl	856 13.2 Pt	*154020*	848 6.2 Lj	861 7.8 BL
V Boo	820 11.7 Ht	R Nor	820[13.3 Bl	848 6.1 Ah	864 7.7 BL
142539a	821 11.5 Bl	*152849*	838[12.5 Dr	848 6.0 L	865 7.7 BL
827 9.5 Ah	825 11.1 Dr	795 9.6 En	R CrB	849 6.0 L	870 7.7 BL
830 9.6 Ah	830 11.0 Dr	801 9.6 Bl	154428	849 6.0 Be	873 7.5 BL
831 9.3 Ch	830 11.1 Dw	814 9.9 Bl	819 6.0 Ch	849 6.2 Lj	R Lib
832 10.4 Ga	835 10.9 Dr	819 9.5 Dr	824 6.0 Ch	849 6.1 Pt	*154715*
833 9.8 Gt	838 11.0 Dr	821 9.0 Bl	825 6.0 Be	850 6.1 Pt	829[13.5 L
833 9.5 An	T Lib	825 9.4 Dr	825 6.0 L	850 6.1 Gt	851[13.5 L
838 9.8 Ah	*150519*	838 9.2 Dr	826 6.0 L	850 6.2 Lj	R Lup
844 10.5 Gt	831[14.1 L	X Lib	827 6.0 Ch	850 6.1 Ah	*154736*
844 10.3 An	Y Lib	*153020*	827 6.1 Ah	851 6.1 Ah	797 11.4 En
849 10.9 Sf	*150605*	801 10.6 Bl	827 6.2 Lj	851 6.0 L	RR Lib
851 10.0 Ah	829 9.3 L	814 10.1 Bl	828 6.2 Lj	851 6.0 An	*155018*
851 10.5 Fd	837 9.6 L	821 10.6 Bl	828 6.1 Ah	851 6.2 Tf	819 10.9 Dr
852 10.7 Gt	846 10.1 L	W Lib	829 6.0 L	851 6.1 Fd	829 11.6 L
852 10.6 An	S Lib	*153215*	829 5.9 An	851 6.2 Lj	837 11.9 L
855 10.1 Ah	*151520*	820[13.0 Bl	829 6.2 Lj	851 6.1 Pt	838 11.8 Dr
856 10.1 Ah	829 10.5 L	S UMi	830 6.2 Lj	852 6.1 Pt	851 12.7 L
856 10.2 Pt	837 10.3 L	153378	830 6.0 Ah	852 6.2 Lj	Z CrB
858 11.4 Jo	846 9.7 L	827 8.8 Lj	830 5.9 L	852 6.2 Tf	155229
866 12.0 Jo	S Ser	829 8.7 Lj	831 6.0 Gt	852 6.2 Ah	829 14.5 L
R Cam	151714	830 8.6 Ah	831 6.0 Be	853 6.1 Pt	RZ Sco
142584	829 12.5 L	831 8.5 Ah	831 5.9 Ah	853 6.1 Fd	*155823*
829[13.2 Br	837 12.1 L	837 8.6 Ah	832 5.9 L	854 6.1 Pt	797 9.1 En
841 14.2 Br	844 10.5 Ch	837 8.7 Lj	833 6.1 An	854 6.0 An	799 9.1 Ht
849 13.4 Br	846 11.6 L	838 8.5 Ah	833 6.0 Gt	854 6.2 Lj	820 8.8 Ht
R Boo	856 9.7 Pt	840 8.4 Ah	835 6.1 Ch	855 6.1 Pt	856 9.3 Pt
143227	857 9.6 Ma	840 8.7 Lj	836 6.0 L	855 5.8 Lg	Z Sco
827 12.3 Lj	S CrB	844 8.6 Ch	837 6.0 L	855 6.2 Lj	*160021*
830 12.3 Lj	151731	846 8.6 Ah	837 6.1 Ah	855 6.3 Tf	797 10.5 En
831 12.1 Ch	827 10.1 Ah	847 8.5 Ah	837 5.9 Tf	855 5.9 Sa	799 11.0 Ht
840 12.4 Lj	830 10.6 Ah	847 8.7 Lj	837 6.2 Lj	855 6.2 Wd	801 10.8 Bl
847 12.4 Lj	831 12.4 Ch	848 8.6 Lj	837 6.0 Be	855 6.1 Ah	814 10.7 Bl
848 12.6 Lj	856 12.4 Pt	848 8.5 Ah	838 6.2 Lj	856 6.2 Ah	820 10.5 Ht
850 12.5 Lj	858 11.0 Jo	848 8.4 Jo	838 6.1 Ah	856 6.1 Fd	821 10.6 Bl
854 12.5 Lj	866 10.5 Jo	849 8.4 Sf	838 6.0 L	856 6.2 Pt	829 10.3 L
856 12.5 Pt	RS Lib	850 8.6 Lj	840 6.0 Gt	857 6.1 Ft	829 10.6 An
S Lup	*151822*	850 8.4 Ah	840 6.2 Lj	858 6.2 Pt	844 9.8 An
144646a	797 8.6 En	851 8.5 Ah	840 6.0 Ah	858 6.0 Jo	844 9.9 Gt
794[12.4 En	797 8.6 Bl	852 8.4 Ah	841 6.2 Lj	859 6.1 Pt	844 9.9 L
819[12.1 En	799 8.6 Ht	854 8.6 Lj	841 6.0 L	866 6.2 Pt	852 10.0 An
Y Lup	814 7.8 Bl	855 8.4 Ah	842 6.1 Fd	866 6.2 Wd	852 9.9 Gt
145254	820 7.9 Ht	856 8.4 Ah	843 6.2 Pt	866 5.9 Jo	R Her
795[13.7 En	821 7.6 Bl	856 8.5 Pt	844 6.2 Pt	X CrB	*160118*
819[13.7 En	829 7.8 L	858 8.4 Sf	844 6.1 Ch	154536	843[10.0 Fd
820[13.7 Bl	830 7.8 An	858 8.1 Jo	844 6.0 L	829 9.7 L	851[10.7 Fd
830 14.0 Dw	837 7.7 L	866 8.1 Jo	845 6.0 Lg	835 9.2 Ch	853[10.7 Fd
830 14.2 Dr	846 8.4 L	866 8.4 Gy	845 6.2 Pt	837 9.2 L	856[10.7 Fd
S Aps		U Lib	846 6.1 Pt	846 8.9 L	U Ser
145971		*153620a*	846 5.8 Lg	856 8.4 Pt	160210
794 11.2 En		801 12.6 Bl	846 6.1 Ah		829 11.8 An

VARIABLE STAR OBSERVATIONS RECEIVED DURING SEPTEMBER, 1929.

J.D.	Est.	Obs.
U SER		
160210		
844	11.2	An
844	11.1	Gt
852	10.8	Gt
852	10.9	An
856	10.3	Pt
857	9.9	Ma
X SCO		
160221a		
820[	13.0	Bl
SX HER		
160325		
829	8.2	L
837	8.7	L
843	9.0	Pt
844	8.9	Pt
845	9.0	Pt
846	9.0	Pt
846	8.7	L
848	9.0	Pt
849	9.0	Pt
855	8.6	Pt
856	8.0	Pt
858	8.2	Pt
859	8.2	Pt
866	8.4	Pt
W SCO		
160519		
820[	13.0	Bl
RU HER		
160625a		
829	13.2	L
830	12.0	Ah
835	12.8	Ch
837	13.4	L
846	13.5	L
856	12.8	Pt
R SCO		
161122a		
797[	12.6	En
799[	12.6	Ht
802[	13.2	Bl
820[	13.2	Bl
856	11.8	Pt
S SCO		
161122b		
797	10.0	En
799	9.6	Ht
802	10.0	Bl
814	10.7	Bl
820	11.2	Bl
856	12.7	Pt
W CRB		
161138		
855	10.0	Sf
856	9.7	Pt
W OPH		
161607		
829	12.0	L

J.D.	Est.	Obs.
W OPH		
161607		
846	12.5	L
V OPH		
162112		
829	10.1	L
846	9.5	L
856	9.0	Pt
U HER		
162119		
827	10.2	Ah
828	11.2	Ah
830	10.1	Ah
831	10.2	Ah
831	10.1	Ch
832	10.0	Gy
837	10.1	Ah
838	10.0	Ah
843	10.3	Fd
847	9.8	Ah
848	9.8	Ah
848	9.5	Jo
849	10.2	Sf
850	9.8	Ah
851	9.9	Ah
852	9.9	Ah
853	10.2	Fd
855	9.9	Ah
856	9.9	Ah
856	10.3	Fd
856	9.8	Pt
858	9.9	Jo
866	9.7	Jo
866	10.3	Sf
Y SCO		
162310		
830	13.9	L
848	14.0	L
SS HER		
162807		
829	13.6	L
844	13.1	L
853	12.9	L
856	12.3	Pt
T OPH		
162815		
802	12.1	Bl
819	13.0	Dr
820	12.9	Bl
830	13.1	L
S OPH		
162816		
820[	13.3	Bl
830	13.7	L
851	12.4	L
W HER		
163137		
824[	11.3	Ch
856	13.5	Pt

J.D.	Est.	Obs.
R DRA		
163266		
824	7.8	Ch
827	7.9	Ah
827	7.8	Lj
828	8.1	Ah
829	8.0	Lj
830	7.9	Ah
831	7.9	Ah
837	8.3	Ah
837	7.9	Lj
838	8.2	Ah
839	8.1	Fd
840	8.1	Fd
840	8.3	Ah
840	8.1	Lj
843	8.3	Fd
846	8.4	Ah
847	8.2	Lj
848	8.2	Lj
848	8.0	Jo
848	8.4	Ah
849	8.0	Fd
849	8.2	Ma
850	8.3	Lj
850	8.5	Ah
851	8.6	Ah
851	8.4	Fd
852	8.5	Fd
852	8.3	Lj
853	8.5	Fd
854	8.4	Lj
854	8.5	Fd
854	8.2	Ma
855	8.6	Ah
855	8.4	Wd
856	8.4	Fd
856	7.9	Pt
856	8.7	Ah
858	8.4	Jo
866	8.5	Ma
866	8.4	Jo
870	8.9	Wd
873	8.8	Ma
RR OPH		
164319		
830	14.0	L
848	14.0	L
S HER		
164715		
827	8.0	Ah
828	8.0	Ah
830	7.9	Ah
831	7.9	Ah
837	7.9	Ah
838	7.9	Ah
839	8.1	Fd
840	8.3	Ah
840	8.1	Lj
843	8.3	Fd
846	8.4	Ah
847	7.8	Ah
848	7.8	Ah

J.D.	Est.	Obs.
S HER		
164715		
850	7.8	Ah
851	8.0	Ah
852	7.9	Ah
855	8.0	Ah
856	8.0	Ah
856	7.5	Pt
RS SCO		
164844		
797	7.5	En
799	7.8	Ht
802	7.2	Bl
814	7.1	Bl
819	7.0	Dr
821	7.0	Bl
835	6.7	Dr
RR SCO		
165030a		
797	10.3	En
799	10.8	Ht
802	9.8	Bl
814	8.7	Bl
819	8.9	Dr
822	7.3	Bl
835	7.8	Dr
RV HER		
165631		
831	11.8	L
833	11.4	An
833	11.4	Gt
838	10.1	L
844	10.1	An
844	10.2	Gt
848	9.9	L
852	10.0	Gt
852	10.5	An
856	9.9	Pt
RT SCO		
165636		
797	8.1	En
802	7.6	Bl
814	7.3	Bl
819	7.3	Dr
822	7.7	Bl
835	7.7	Dr
— DRA		
165752		
831	11.2	L
838	11.0	L
848	10.0	L
R OPH		
170215		
818	7.8	Ch
821	7.6	Ch
830	7.8	L
838	7.9	L
848	8.4	L
848	8.4	Jo
856	8.4	Ft

J.D.	Est.	Obs.
R OPH		
170215		
858	8.8	Jo
866	8.9	Jo
RT HER		
170627		
831	13.8	L
848	13.8	L
RW SCO		
170833		
797[	12.5	En
820	11.4	Bl
835	9.6	Dr
Z OPH		
171401		
827	8.2	Ah
828	8.2	Ah
830	8.0	Ah
831	8.2	Ah
837	7.8	Ah
838	8.1	Ah
846	8.0	Ah
848	7.9	Ah
851	8.0	Ah
852	7.9	Ah
855	8.0	Ah
856	7.9	Ah
856	7.5	Pt
RS HER		
171723		
856	8.4	Pt
S OCT		
172486		
797	12.0	En
802	12.5	Bl
819	13.0	Dr
821	13.3	Bl
835	13.5	Dr
RU OPH		
172809		
829	11.7	An
830	11.9	L
837	11.5	An
838	11.3	L
847	10.1	An
847	9.5	Gt
848	10.8	L
856	9.2	Pt
RT SER		
173411		
830	12.2	L
848	12.5	L
RU SCO		
173543		
797	10.2	En
802	10.2	Bl
814	9.6	Bl
819	9.6	Dr
821	9.5	Bl
835	9.1	Dr

J.D.	Est.	Obs.
SV SCO		
174135		
797	11.4	En
802	11.4	Bl
814	11.5	Bl
819	12.0	Dr
822	12.0	Bl
835	12.8	Dr
W PAV		
174162		
797[	12.3	En
821[	13.0	Bl
829[	14.3	Dr
RS OPH		
174406		
856	11.2	Pt
U ARA		
174551		
835	12.6	Dr
RY HER		
175519		
831	13.5	L
848	14.0	L
856	13.5	Pt
V DRA		
175654		
830	10.6	L
841	10.8	L
853	12.4	L
856	12.5	Pt
R PAV		
180363		
829	13.6	Dw
829	13.4	Dr
T HER		
180531		
827	8.7	Ah
828	8.7	Ah
830	8.7	Ah
830	8.6	L
831	8.6	Ah
833	8.7	Gt
833	8.8	An
837	8.6	Ah
837	8.7	Tf
838	8.2	L
838	8.6	Ah
839	8.5	Fd
840	8.5	Fd
840	8.6	Ah
842	8.5	Fd
843	8.4	Fd
844	8.5	Gt
844	8.4	An
845	8.7	Tf
846	8.4	Ah
847	8.4	Ah
848	8.3	Ah
848	8.1	L
848	8.0	Jo

VARIABLE STAR OBSERVATIONS RECEIVED DURING SEPTEMBER, 1929.

J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.
T HER	RV SGR	R SCT	R SCT	ST SGR	S LYR
180531	*182133*	*184205*	*184205*	*185512a*	190925
849 8.3 Fd	802 8.0 Bl	827 6.0 Lj	851 7.6 Tf	838 9.0 L	832 12.4 L
850 8.4 Ah	814 8.0 Bl	828 6.0 Lj	851 7.7 Lj	851 9.3 L	841 11.9 L
851 8.3 Ah	819 7.9 Dr	829 6.0 Lj	851 7.2 Fd	R CRA	851 12.0 L
851 8.4 Tf	822 8.0 Bl	829 6.0 An	851 7.4 Gt	*185537a*	856 11.8 Pt
851 8.5 Fd	835 8.4 Dr	830 6.1 Lj	852 7.4 Gt	798[12.5 En	X LYR
852 8.4 Fd	SV HER	830 6.0 An	852 7.8 Lj	802 13.0 Bl	190926
852 8.5 Gt	182224	830 6.2 L	852 7.2 Fd	821 13.5 Bl	856 9.0 Pt
852 8.3 An	830 10.2 L	830 6.0 Be	852 7.6 Tf	T CRA	RS LYR
852 8.3 Ah	833 10.5 An	831 5.9 Gt	852 7.3 An	*185537b*	190933a
852 8.4 Tf	833 10.8 Gt	831 5.9 An	853 7.7 Tf	802[13.0 Bl	830 11.8 L
853 8.4 Fd	841 10.7 L	833 6.0 An	853 8.5 Pt	821 13.7 Bl	841 11.8 L
854 8.5 Fd	844 10.7 An	833 6.0 Gt	853 7.0 Fd	Z LYR	851 12.7 L
855 8.4 Ah	844 10.8 Gt	834 6.8 Ch	854 7.9 Lj	185634	856 12.2 Pt
855 8.0 Tf	852 11.2 Gt	836 6.4 L	854 7.5 Sa	832 13.5 L	RU LYR
856 8.4 An	852 11.3 An	836 6.1 An	854 7.5 An	837 13.0 Br	190941
856 8.4 Fd	852 11.1 L	836 6.3 Gt	854 6.9 Fd	851 12.9 L	830[14.0 L
856 8.2 Pt	856 11.4 Pt	837 7.0 Lj	855 7.5 An	RT LYR	832[14.0 L
858 8.3 Jo	T SER	837 6.2 An	855 7.4 L	185737	837[14.0 Br
866 8.5 Jo	182306	837 7.0 Tf	855 7.6 Tf	837 14.1 Br	U DRA
W DRA	856 9.7 Pt	838 6.5 An	855 7.6 Sa	851[13.9 L	*190967*
180565	SV DRA	838 7.0 Lj	855 7.6 Wd	R AQL	830 13.0 L
830 8.9 L	183149	838 6.5 Gt	855 7.9 Lj	190108	839 13.0 Bi
841 9.0 L	830 11.3 L	839 6.6 Pt	855 7.5 Pt	822 11.4 Ch	841 12.7 L
853 9.4 L	841 11.5 L	839 6.5 Gb	855 7.3 Ma	828 11.0 Ah	851 12.6 L
856 9.8 Pt	849 11.6 Ma	840 7.0 Gt	855 7.5 Lg	830 10.9 Ah	856 12.6 Pt
X DRA	853 12.1 L	840 7.0 An	856 7.6 Pt	837 11.3 Ah	W AQL
180666	857 12.2 Ma	841 7.0 Lj	856 6.9 Fd	838 11.2 Ah	*191007*
841 14.0 L	866 12.4 Ma	841 6.6 L	857 8.0 Pt	851 11.3 Ah	856 8.9 Pt
853 14.0 L	RZ HER	842 7.0 An	857 7.7 Lg	855 11.4 Ah	T SGR
TV HER	183225	843 7.0 Pt	858 7.4 Pt	856 11.4 Ah	*191017*
181031	831 12.5 L	844 6.9 Pt	858 7.2 Jo	856 11.5 Pt	831 11.8 Ch
839 12.2 L	851 13.0 L	844 6.4 Lg	859 7.5 Pt	V LYR	831 11.4 L
848 12.5 L	X OPH	844 7.1 Gt	861 6.9 Lg	190529a	838 11.5 L
RY OPH	183308	844 7.2 An	865 6.9 Pt	830 10.4 L	852 10.9 L
181103	829 6.7 An	844 7.0 Ch	866 6.6 Pt	841 10.9 L	856 11.0 Pt
827 9.7 Ah	830 6.5 L	845 7.0 Pt	866 6.9 Jo	852 11.0 L	R SGR
828 9.8 Ah	838 6.1 L	845 6.6 Lg	866 6.8 Wd	RX SGR	*191019*
856 13.0 Pt	839 6.6 An	845 7.4 Tf	870 6.7 Wd	*190818*	831 11.5 Ch
W LYR	847 6.6 An	846 6.9 Pt	Nov AQL	798 9.9 En	831 11.5 L
181136	847 6.5 Gt	846 6.8 Lg	184300	830 10.6 L	838 11.0 L
828 9.1 Ah	848 6.5 Jo	847 6.9 Lg	822 10.6 Ch	838 10.8 L	852 10.2 L
829 9.3 An	851 6.3 L	847 7.6 Lj	839 11.9 Pt	851 11.5 L	856 9.6 Pt
830 9.4 Ah	856 6.5 Pt	847 7.3 An	843 11.8 Pt	856 12.0 Pt	RY SGR
830 9.6 L	858 6.7 Jo	847 7.2 Gt	855 11.7 Pt	RW SGR	*191033*
838 10.0 Gt	866 6.8 Jo	848 7.5 Sf	855 10.4 Ma	*190819a*	798 6.3 En
838 10.1 An	RY LYR	848 7.7 Lj	865 11.8 Pt	798 10.2 En	802 6.0 Bl
839 10.0 Gb	184134	848 7.2 L	RX LYR	830 9.8 L	803 6.0 En
841 9.8 L	830 11.6 L	848 7.0 Jo	185032	838 9.4 L	814 5.5 Bl
847 10.7 Gt	841 11.9 L	848 7.5 Pt	837[14.1 Br	851 9.4 L	821 5.8 Bl
847 10.8 An	852 12.1 L	849 7.5 Pt	855[13.4 L	856 9.0 Pt	824 6.9 Dr
848 10.5 Jo	R SCT	849 7.3 Gb	S CRA	BH SGR	824 6.9 Ch
850 11.2 Ah	*184205*	849 7.6 Lj	*185437a*	*190819b*	825 6.5 L
851 11.3 Ah	818 5.6 Ch	849 7.4 Be	798 12.7 En	839 13.3 L	830 6.8 L
852 10.4 L	822 5.8 Ch	850 7.6 Lj	802 11.5 Bl	851 12.0 L	830 6.8 Dr
855 11.1 Ah	825 6.0 L	850 7.4 An	821 12.1 Bl	TY AQL	830 6.9 Dw
856 11.0 Pt	825 5.5 Be	850 7.3 Gt	ST SGR	*190907*	831 6.5 L
858 11.2 Jo	826 6.0 Ch	851 7.2 An	*185512a*	856 10.6 Pt	835 6.8 Dr
	826 6.1 Sa	851 7.3 L	830 9.1 L		836 6.4 L

VARIABLE STAR OBSERVATIONS RECEIVED DURING SEPTEMBER, 1929.

J.D.Est.Obs. J.D.Est.Obs. J.D.Est.Obs. J.D.Est.Obs. J.D.Est.Obs. J.D.Est.Obs.

RY SGR
191033
837 6.2 L
837 6.3 An
838 6.3 Dr
841 6.4 L
843 5.9 L
844 5.9 L
844 6.3 Pt
845 6.3 Pt
846 6.4 Pt
848 6.3 Pt
849 6.4 Pt
852 6.1 An
852 6.2 Tf
852 6.1 Gt
852 6.4 L
853 6.4 Tf
855 6.2 Tf
855 6.5 Pt
856 6.5 Pt
859 6.6 Pt
866 6.5 Pt

TY SGR
191124
798 11.6 En
802 12.0 Bl
819 12.8 Dr
821 13.0 Bl
835 13.4 Dr

S SGR
191319a
821[13.5 Bl
831 14.1 L
852 14.2 L

SW SGR
191331
802[12.9 Bl
821 13.3 Bl
829 12.8 Dw
829 12.7 Dr

TZ CYG
191350
856 10.8 Pt

U LYR
191637
837 7.2 Ah
840 7.4 Ah
840 7.7 Ah
847 7.5 Ah
848 7.5 Ah
850 7.6 Ah
856 7.6 Ah
856 11.1 Pt

TY CYG
192928
831 11.8 L
834 11.9 Ch
841 12.1 L
852 12.1 L

TY CYG
192928
856 12.6 Pt

RT AQL
193311
831 12.7 L
834 12.9 Ch
842 11.7 L
851 10.7 L
856 10.3 Ah
856 10.1 Pt

R CYG
193449
821 9.4 Ga
827 9.0 Ah
830 9.1 Ah
834 8.6 Ch
839 8.9 Gb
839 9.0 Fd
840 9.4 Ah
848 9.7 Ah
848 9.3 Jo
850 9.7 Ah

RV AQL
193509
831 10.0 L
845 10.8 L
854 11.7 L
856 12.2 Pt

T PAV
193972
798 9.5 En
802 9.8 Bl
814 10.4 Bl
819 11.1 Dr
822 11.1 Bl
835 11.7 Dr

RT CYG
194048
827 10.0 Ah
830 10.2 Ah
834 9.6 Ch
839 10.2 Fd
839 11.0 Gb
856 11.2 Pt

TU CYG
194348
825 13.1 L
834 12.9 Ch
835 12.6 L

TU CYG
194348
851 11.7 L
837 13.8 L
852 13.6 L

X AQL
194604
825 13.8 L

χ CYG
194632
818 5.4 Ch
822 5.4 Ch
827 5.5 Ch
827 6.3 Ah
828 5.9 Ah
829 5.8 An
830 5.8 Ah
831 6.0 Ah
837 6.0 Ah
838 6.0 Ah
838 6.0 Ch
840 6.0 Ah
840 6.8 Gt
840 6.4 An
846 6.3 Ah
847 6.3 Ah
848 6.4 Ah
849 6.8 Ma
849 6.5 Jo
850 6.4 Ah
850 6.5 Gt
850 7.1 An
851 6.5 Ah
852 6.6 Ah
855 6.7 Ah
855 6.5 Wd
856 6.7 Ah
856 6.4 Pt
858 6.6 Jo
866 7.3 Wd
866 6.8 Jo
870 7.3 Ma
870 7.3 Wd
873 7.3 Ma

S PAV
194659
798 7.5 En
829 6.9 Dr
835 6.8 Dr

RR SGR
194929
802 7.8 Bl
814 8.5 Bl
819 8.3 Dr
821 9.0 Bl
835 9.3 Dr

S SGE
195116
852 5.7 Tf
853 5.9 Tf

RU SGR
195142
798 8.2 En
802 7.9 Bl
814 7.6 Bl
819 7.2 Dr
821 7.4 Bl
821 7.7 Sm
835 7.5 Dr

RR AQL
195202
852[13.1 L

RS AQL
195308
825 11.2 L
837 11.8 L
852 12.6 L

NOV CYG
195553
839[12.2 Pt
843[12.2 Pt
850[11.6 Ma
854[11.6 Ma
855[12.2 Pt
865[12.2 Pt
870[11.6 Ma

Z CYG
195849
822 8.5 Ch
825 8.3 L
835 8.3 L
851 8.5 L
856 8.4 Pt

S TEL
195855
798[12.6 En
822 13.0 Bl

SY AQL
200212
825[14.3 L
829[12.7 An
840[12.7 Gt
848[13.2 Br
850[12.7 Gt
852 14.3 L
856 12.7 Pt

BU CYG
200250
826 11.6 Lj
829 11.6 Lj
837 11.6 Lj
840 11.5 Lj
848 11.2 Lj
850 11.3 Lj
852 11.3 Lj
854 11.5 Lj

S CYG
200357
835[14.3 L
848[13.8 Br
867[13.8 Br

R CAP
200514
832 13.4 L
852 12.6 L
856 12.4 Pt

S AQL
200715a
822 9.3 Ch
829 9.3 An
840 9.4 An
840 9.4 Gt
850 9.5 Gt
850 9.5 An
854 9.6 Sa
856 10.0 Pt

RW AQL
200715b
854 9.1 Sa
856 9.3 Pt

R TEL
200747
822[14.0 Bl
829 14.5 Dw

RU AQL
200812
832 13.8 L
848 14.0 Br
852 14.2 L

W CAP
200822
802[12.8 Bl
821[13.3 Bl

Z AQL
200906
856 10.3 Pt

RS CYG
200938
822 7.2 Ch
825 7.3 L
835 7.3 L
839 7.2 Ch
839 7.2 Gb
848 7.2 Jo
851 7.2 L
855 7.2 Wd
856 7.2 Pt
858 7.2 Jo
866 7.1 Jo

R DEL
201008
825 8.8 L
827 9.1 Ah
828 9.1 Ah
829 9.1 An
830 9.2 Ah

R DEL
201008
836 9.5 L
837 9.6 Ah
838 9.6 Ah
840 9.7 An
840 9.7 Gt
850 10.3 An
850 10.3 Gt
851 9.9 Ah
852 9.8 L
853 10.5 Br
855 10.3 Ah
856 10.3 Ah
856 10.5 Pt

RT CAP
201121
856 6.3 Pt

SX CYG
201130
832 13.9 L
839[13.1 Ch
851[13.1 Br

RT SGR
201139
802 10.8 Bl
814 10.0 Bl
821 9.8 Bl
835 9.7 Dr

WX CYG
201437b
825 11.3 L
835 11.4 L
851 12.0 L
856 12.1 Pt

U CYG
201647
813 8.0 Ga
830 7.8 Ah
831 7.8 Ah
837 7.8 Ah
839 7.7 Ch
839 8.0 Fd
847 7.8 Ah
848 7.8 Ah
848 7.8 Jo
850 8.1 Sf
850 7.9 Ah
852 7.9 Ah
852 7.9 Fd
853 8.0 Fd
856 8.0 Fd
856 7.8 Ah
856 7.8 Pt
857 8.6 Wd
858 7.6 Jo
866 8.0 Wd
866 7.6 Jo
870 8.0 Wd

VARIABLE STAR OBSERVATIONS RECEIVED DURING SEPTEMBER, 1929.

J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.
U MIC	V CYG	RZ CYG	RS AQR	T CAP	R GRU
202240	203847	204846	*210504*	*211615*	*214247*
802 8.7 Bl	850 9.6 Sf	856 13.0 Pt	827 10.6 L	802 10.4 Bl	798[12.4 En
814 8.3 Bl	853 9.6 Br	S IND	836 10.2 L	822 11.4 Bl	802 12.8 Bl
819 8.7 Dr	854 9.0 Ma	*204954*	853 9.8 L	827 11 7 L	821[12.4 En
821 8.8 Bl	856 9.3 Pt	798 8.1 En	856 9.5 Pt	836 12.9 L	822 13.3 Bl
835 9.0 Dr	870 8.7 Ma	802 8.6 Bl	Z CAP	853 13.1 L	838[13.3 Dr
RW CYG	Y AQR	814 8.7 Bl	*210516*	S MIC	V PEG
202539	*203905*	819 8.7 Dr	856 9.2 Pt	*212030*	215605
830 9.1 An	839[12 3 Ch	822 9.0 Bl	R EQU	802[13.4 Bl	827 11.3 L
840 8.9 An	852 13.1 An	835 9.7 Dr	210812	822 12.3 Bl	836 11.8 L
840 8.9 Gt	852 13.2 Gt	X DEL	827 12.7 L	838 10.2 Dr	851 12.5 L
850 8.8 Gt	T DEL	205017	836 12.8 L	Y CAP	853 12.2 Br
850 8.7 An	204016	827 10.6 L	850 13.8 Br	*212814*	858 13.0 Pt
Z DEL	827 14.3 L	836 10.7 L	853 13.7 L	802 12.2 Bl	U AQR
202817	830[13.3 An	849 11.3 L	T CEP	822 12.5 Bl	*215717*
827 11.3 L	834[12.9 Ch	853 12.4 Br	210868	827 12.4 L	827 12.0 L
836 11.0 L	840[12.5 Gt	856 12.2 Pt	819 8.7 Ch	853 13.4 L	839 12.0 L
849 10.7 L	850[13.3 An	RR CAP	825 8.5 Ch	W CYG	853 12.2 L
856 10.1 Pt	851[14.3 Br	*205627*	827 7.7 Ah	213244	865 12.1 Pt
ST CYG	853[13.5 L	819 9.7 Dr	828 7.9 Ah	826 5.5 L	RT PEG
202954	U DEL	835 10.5 Dr	830 7.9 Ah	831 5.2 Gt	215934
832 9.7 L	204017	T OCT	831 7.9 Ah	835 5.5 L	827 12.7 L
842 10.6 L	837 6.7 Tf	*205782*	834 7.6 Ch	836 6.1 An	839 13.5 L
849 10.7 L	845 6.7 Tf	819 13.4 Dr	837 7.8 Ah	836 5.5 Gt	851 14.0 L
851 10.8 Br	851 6.7 Tf	R VUL	838 7.7 Ah	845 5.5 Tf	852 14.0 Br
856 11.4 Pt	V AQR	205923a	839 7.7 Ch	846 5.4 L	RZ PEG
867 11.4 Br	204102	851 13.2 Br	839 7.9 Fd	851 5.6 L	220133b
V VUL	827 9.9 L	856 12.0 Pt	840 7.9 Ah	851 6.0 An	831 12.7 L
203226	836 9.6 L	RS CAP	846 7.6 Ah	851 5.4 Gt	839 13.0 L
856 8.7 Pt	853 8.9 L	*210116*	847 7.6 Ah	852 5.8 Tf	851 12.8 L
R MIC	856 8.9 Pt	829 8.6 An	848 7.9 Ah	S CEP	T PEG
203429	W AQR	840 8.2 An	849 7.1 Jo	213678	220412
821 10.7 Bl	*204104*	840 8.0 Gt	849 7.6 Fd	825 10.3 Ch	831 13.4 L
Y DEL	827 9.9 L	850 8.1 Gt	850 7.6 Ah	828 10.3 Ah	839 13.3 L
203611	836 10.2 L	850 8.4 An	851 7.6 Ah	849 10.6 Sf	855 14.0 L
827 10.2 L	853 11.4 L	V CAP	852 7.6 Ah	849 9.7 Jo	858 14.0 Br
836 10.4 L	U CAP	*210124*	852 7.5 Fd	853 10.4 Br	Y PEG
849 11.2 L	*204215*	802 11.0 Bl	853 8.3 Fd	856 10.1 Pt	220613
858 12.0 Br	802[13.5 Bl	822 11.8 Bl	855 7.5 Ah	858 10.0 Jo	831 12.4 L
S DEL	822 13.7 Bl	838 13.2 Dr	855 8.1 Wd	RU CYG	839 11.9 L
203816	827 13.9 L	TW CYG	856 7.8 Fd	213753	852 11.3 Br
827 10.9 Lj	853 13.9 L	210129	856 7.5 Ah	828 8.8 Ah	855 11.2 L
829 10.9 Lj	V DEL	827 10.4 L	856 7.2 Pt	830 8.9 Ah	858 11.5 Pt
837 10.5 Lj	204318	836 9.8 L	858 6.9 Jo	831 8.9 Ah	RS PEG
840 9.9 Lj	853[14.4 Br	839 10.2 Ch	RR AQR	837 9.4 Ah	220714
848 9.9 Lj	855[11.8 Ma	849 10.5 L	*210903*	851 9.2 Ah	831 11.3 L
850 10.1 Lj	858[13.9 Br	X CAP	827 11.2 L	852 9.6 Ah	839 11.5 L
854 9.9 Lj	T AQR	*210221*	836 10.2 L	855 9.5 Ah	852 11.6 Br
854 8.9 Sa	*204405*	802[12.7 Bl	853 9.9 L	856 9.6 Ah	853 12.2 L
856 8.9 Pt	839 9.2 Ch	822[13.3 Bl	856 9.3 Pt	856 9.8 Pt	R PSA
V CYG	849 10.5 Jo	X CEP	X PEG	RV CYG	*221230*
203847	852 10.2 Gt	210382	211614	213937	799 13.5 Dr
830 9.9 Ah	852 10.2 An	825[11.4 Ch	827 12.9 L	826 6.8 L	838 12.2 Dr
832 8.7 L	854 11.0 Sa	839[13.9 Br	836 13.3 L	835 6.8 L	S GRU
837 10.0 Ah	856 11.0 Pt	849[13.9 Br	851 13.7 Br	858 6.3 Pt	*221948*
839 9.3 Ch	858 11.0 Jo	858[13.9 Br	853 14.7 L	RR PEG	819 9.5 Dr
842 8.5 L	866 11.3 Jo	867[13.9 Br		214024	821 10.0 En
849 8.7 L				851 13.3 Br	838 10.3 Dr
850 8.7 Ma					

Variable Star Observations Received During September, 1929.

J.D.	Est.	Obs.	J.D.	Est.	Obs.	J.D.	Est.	Obs.	J.D.	Est.	Obs.	J.D.	Est.	Obs.	J.D.	Est.	Obs.
RV Peg			**RW Peg**			**V Cas**			**S Peg**			**R Aqr**			**R Cas**		
222129			225914			230759			231508			*233815*			235350		
831	13.7	L	838	12.3	Ch	**831**	8.4	Ah	**827**	9.5	Ah	849	9.4	Jo	839	11.8	Ch
835	13.1	Ch	853	10.3	Br	837	8.5	Ah	830	9.6	Ah	850	8.7	L	840	11.6	Br
839	13.7	L	**R Peg**			838	8.4	Ah	831	9.2	L	**851**	9.1	Tf	854	10.8	Bn
852	13.7	Br	230110			839	8.0	Ch	837	10.0	Ah	852	8.9	An	858	10.9	Bn
855	13.7	L	826	8.0	Ch	840	8.4	Ah	838	10.2	Ch	852	8.8	Gt	866	11.3	Bn
858	13.7	Br	**827**	**8.2**	**Ah**	**846**	8.8	Ah	839	9.7	L	855	8.6	Ma	867	10.3	Br
S Lac			828	8.2	Ah	**847**	8.8	Ah	850	10.3	L	855	9.0	Tf	**Z Peg**		
222439			830	8.2	Ah	848	8.8	Ah	858	10.3	Br	858	8.8	Pt	235525		
830	**9.8**	**An**	**831**	**8.2**	**Ah**	850	8.7	Ah	**865**	11.6	Pt	858	9.6	Jo	827	9.3	Lj
831	9.8	L	**837**	**8.7**	**Ah**	851	8.8	Ah	**Z And**			870	9.0	Ma	**830**	9.6	Lj
839	**9.4**	**L**	838	8.6	Ah	852	8.9	Ah	232848			**Z Cas**			831	9.1	L
844	9.7	Gt	840	8.7	Ah	852	9.2	Sf	858	9.5	Pt	233956			837	10.2	Lj
844	9.6	An	848	9.0	Ah	855	8.9	Ah	**ST And**			850	13.8	L	838	10.0	Ch
849	**8.9**	**L**	849	9.2	Sf	**856**	9.1	Ah	233335			858	14.4	Br	839	9.6	L
852	**8.5**	**Br**	850	9.1	Ah	858	9.1	Pt	827	9.3	Lj	**RS Cas**			841	10.1	Lj
852	9.1	An	851	9.1	Ah	866	9.5	Sf	830	9.4	Lj	235053			848	10.4	Lj
852	9.0	Gt	852	9.1	Ah	867	9.1	Br	837	9.3	Lj	859	11.1	Br	849	10.4	Lj
858	9.0	Pt	855	9.3	Ah	**W Peg**			838	9.5	Ch	**V Cet**			854	10.5	Lj
R Ind			**856**	**9.3**	**Ah**	231425			840	9.5	Lj	235209			855	10.7	L
222867			858	9.7	Br	831	8.8	L	848	9.5	Lj	822	12.6	Bl	859	10.9	Br
802	9.9	Bl	858	9.5	Pt	833	9.1	An	850	9.5	Lj	831	13.9	L	865	11.4	Pt
814	9.9	Bl	866	9.8	Gy	833	9.0	Gt	854	9.6	Lj	**WY Cas**			**Y Cas**		
819	10.5	Dr	**V Cas**			839	8.8	L	858	9.4	Pt	235255			*235855*		
822	10.7	Bl	230759			844	9.1	An	**R Aqr**			850	12.4	Br	831	14.0	L
R Lac			827	8.0	Ah	844	9.1	Gt	*233815*			**R Tuc**			**855**	14.0	L
223841			828	8.2	Ah	850	8.7	L	822	8.5	Bl	*235265*			**SV And**		
831	14.0	L	830	8.1	Ah	852	9.0	Gt	825	8.8	Ch	821	12.4	En	235939		
839	13.7	L				852	9.1	An	831	8.7	L	826	14.1	Dr	859	11.5	Br
850	13.5	L							**837**	9.2	Tf	826	14.2	Dw	865	11.6	Pt
									839	8.7	L						

Rapidly Varying Irregular Variables.

Star	J.D.	Est.	Obs.	J.D.	Est.	Obs.	Star	J.D.	Est.	Obs.	J.D.	Est.	Obs.
005840	RX Andromedae—						074922	U Geminorum—					
	5839.9	11.6	Pt	5857.7	11.9	Pt		5849.6	12.4	L			
	5840.9	11.7	Pt	5858.7	11.5	Br	081473	Z Camelopardalis—					
	5853.8	11.4	Br	5859.7	11.6	Br		5825.4	11.5	L	5838.6	11.2	L
	5855.7	11.7	Pt	5864.8	11.5	Pt		5826.3	11.6	L	5839.6	12.1	L
	5856.7	11.8	Pt					5827.6	11.8	L	5840.3	11.7	Gt
010884	RU Cephei—							5828.6	11.8	L	5840.4	12.2	An
	5832.6	8.7	L	5855.4	8.8	L		5829.4	11.4	L	5841.3	11.8	L
	5842.6	8.7	L					5830.4	11.4	L	5842.6	12.3	L
060547	SS Aurigae—							5830.4	11.7	An	5843.3	12.3	L
	5825.6	12.0	L	5840.9	12.6	Pt		5831.6	11.7	L	5843.6	12.2	L
	5827.6	13.3	L	5841.6	13.9	L		5832.6	11.7	L	5844.3	12.3	L
	5828.6	13.5	L	5842.6	13.9	L		5833.4	11.2	Gt	5844.6	12.3	L
	5829.6	13.9	L	5843.6	13.3	L		5833.4	11.4	An	5845.6	12.3	L
	5830.6	13.3	L	5845.6	13.9	L		5833.7	11.7	L	5846.4	12.2	L
	5831.6	10.8	L	5846.6	13.9	L		5835.6	11.5	L	5846.6	12.0	L
	5832.6	10.8	L	5847.6	13.3	L		5836.3	11.3	L	5847.6	11.4	L
	5833.6	11.9	L	5849.6	13.3	L		5836.6	11.4	L	5849.6	11.4	L
	5835.6	12.3	L	5850.6	13.3	L		5837.4	11.4	L	5850.6	11.4	L
	5836.6	13.0	L	5851.6	13.3	L		5837.4	11.6	An	5851.4	11.3	An
	5837.6	13.9	L	5854.6	13.3	L		5838.4	11.4	L	5851.4	11.3	Gt
	5838.6	13.9	L	5855.7	11.0	Pt		5838.4	11.8	Gt	5851.6	11.4	L
	5839.9	12.6	Pt	5857.7	12.4	Pt		5838.4	11.6	An	5852.4	11.3	L

Star	J.D.	Est.	Obs.	J.D.	Est.	Obs.
081473 Z Camelopardalis—						
	5854.3	12.0	L	5855.4	12.8	L
	5854.6	12.4	L			
202946 SZ Cygni—						
	5839.9	8.9	Pt	5853.7	9.6	Pt
	5840.8	8.8	Pt	5855.7	8.9	Pt
	5843.7	9.0	Pt	5856.7	9.2	Pt
	5844.7	9.0	Pt	5857.7	9.0	Pt
	5845.7	9.2	Pt	5858.7	9.3	Pt
	5846.7	9.3	Pt	5859.7	9.6	Pt
	5848.7	9.4	Pt	5865.8	9.6	Pt
	5849.7	9.4	Pt	5866.7	9.5	Pt
213843 SS Cygni—						
	5819.2	11.8	Ch	5836.3	11.7	L
	5825.3	11.2	L	5836.4	11.7	Gt
	5826.3	11.0	L	5836.4	11.6	An
	5826.6	11.9	Lj	5836.5	12.1	L
	5826.6	11.2	Sa	5837.4	11.6	L
	5827.2	11.7	Ch	5837.4	11.9	Ah
	5827.4	11.6	Lj	5837.4	11.6	An
	5827.5	11.8	Ah	5837.4	11.8	Lj
	5827.5	11.5	L	5837.6	11.7	L
	5828.4	11.9	Ah	5837.7	11.9	Br
	5828.4	11.8	Lj	5838.3	11.5	L
	5828.6	11.9	L	5838.4	11.7	Gt
	5829.4	11.6	L	5838.4	11.8	Lj
	5829.4	11.9	Lj	5838.6	12.0	L
	5829.4	12.1	An	5839.1	11.8	Ch
	5830.4	11.5	An	5839.6	11.7	L
	5830.4	11.9	Lj	5839.7	11.4	Br
	5830.4	11.8	Ah	5839.9	11.6	Pt
	5830.6	11.6	L	5840.3	11.6	L
	5831.2	11.9	Ch	5840.3	11.9	Lj
	5831.4	11.6	An	5840.4	11.6	Gt
	5831.4	11.9	Ah	5840.4	11.6	An
	5831.4	11.6	Gt	5840.7	11.9	Br
	5831.6	11.8	L	5840.9	11.6	Pt
	5832.4	11.6	L	5841.3	11.5	L
	5833.3	12.0	An	5841.4	11.9	Lj
	5833.3	11.9	Gt	5841.6	12.0	L
	5833.6	11.9	L	5841.7	11.8	Br
	5834.1	11.9	Ch	5842.6	11.5	L
	5835.1	11.9	Ch	5843.3	11.1	L
	5835.6	12.1	L	5843.6	11.4	L
213843 SS Cygni—						
	5843.7	11.9	Br	5852.3	11.7	Lj
	5843.7	11.7	Pt	5852.4	10.9	L
	5844.3	11.5	L	5852.4	11.1	Gt
	5844.4	11.6	Gt	5852.4	11.1	An
	5844.4	11.5	An	5852.7	11.5	Br
	5844.6	11.4	L	5852.7	11.7	Fd
	5844.7	11.8	Pt	5853.3	11.6	L
	5844.7	11.6	Br	5853.7	11.6	Br
	5845.3	11.3	L	5853.8	12.0	Fd
	5845.6	11.5	L	5854.3	11.6	Lj
	5845.7	11.7	Br	5854.3	11.5	L
	5845.7	11.7	Pt	5854.9	11.2	Ma
	5846.3	11.2	L	5855.3	11.7	Lj
	5846.6	11.7	L	5855.4	11.8	Ah
	5846.7	11.7	Pt	5855.3	11.0	L
	5847.3	11.5	Lj	5855.7	11.6	Pt
	5847.4	11.5	Gt	5855.7	10.6	Ma
	5847.4	11.3	An	5856.3	11.8	Ah
	5847.6	11.2	L	5856.7	11.7	Pt
	5847.7	11.7	Br	5856.8	11.8	Fd
	5848.3	11.3	L	5857.6	11.3	Sa
	5848.3	11.4	Lj	5857.7	11.6	Ma
	5848.7	11.7	Pt	5857.7	11.7	Pt
	5848.7	11.5	Br	5857.7	11.2	Lg
	5849.3	10.9	L	5857.7	11.7	Br
	5849.3	11.1	Lj	5858.6	11.8	Jo
	5849.6	11.3	L	5858.7	11.7	Pt
	5849.6	11.7	Jo	5858.7	11.7	Br
	5849.8	11.2	Ma	5858.7	11.5	Ma
	5849.7	11.6	Br	5859.7	11.7	Pt
	5850.3	11.8	Lj	5859.7	11.6	Br
	5850.4	11.6	Gt	5860.7	11.6	Br
	5850.4	11.7	An	5861.7	11.3	Lg
	5850.5	11.8	Ah	5862.7	11.5	Br
	5850.6	11.9	L	5863.7	11.6	Br
	5850.7	11.7	Br	5865.7	11.8	Br
	5851.3	11.0	L	5865.8	11.7	Pt
	5851.3	11.0	An	5866.6	11.8	Jo
	5851.4	11.4	Lj	5866.7	11.5	Ma
	5851.4	11.8	Ah	5866.7	11.7	Pt
	5851.4	11.4	Gt	5867.7	11.2	Br
	5851.6	11.7	L	5869.8	11.1	Ma
	5851.7	11.7	Br	5870.8	9.7	Ma
	5852.3	11.7	Ah	5873.7	8.3	Ma

Summary of Observations, September, 1929.

Observer	Initial	Vars.	Observations	Observer	Initial	Vars.	Observations
Ahnert	Ah	44	337	Ford	Fd	17	86
Ancarani	An	32	108	Gaebler	Gb	7	8
Baldwin	Bl	96	199	Gallanti	Gt	30	82
Benini	Be	2	7	Gregory	Gy	5	5
Boutell	BL	6	22	Grossman	Ga	5	5
Brocchi	Br	51	84	Houghton	Ht	31	46
Brown	Bn	3	7	Jones	Jo	37	99
Chandra	Ch	43	85	Lacchini	L	173	576
Dartayet	Dr	65	105	Leiner	Lj	14	130
Dawson	Dw	11	11	Logan	Lg	3	12
Ensor	En	61	83	Marsh	Ma	15	37

Observer	Initial	Vars.	Observations	Observer	Initial	Vars.	Observations
Peltier	Pt	157	263	Taffara	Tf	11	35
Sanders	Sa	8	10	Webb	Wd	10	24
Smith, F. W.	Sf	11	16				
Smith, W. H.	Sm	11	11	Totals	28	386	2493

LEON CAMPBELL, Recording Secretary.

October 10, 1929.

NOTES FROM AMATEURS.

Two Laws Concerning the Planetary Masses.*

By whatever process the Solar System came into being, or grew to be what it is, it is reasonable to suppose that the planetary masses would indicate a relation or law of mass to mass among themselves. I desire to show that such laws do exist.

During the year 1875 while contemplating the table of the masses of the planets given by Mr. R. A. Proctor in his book "Expanse of Heaven," I observed a peculiar relation of the masses of the smaller inner family of planets to the masses of the larger outer family of planets. This relation can be seen in the following table given by him:

	Mass (Earth's as 1000)	Distance from the Sun (Earth's as 100)
The Sun	315,000,000	....
Mercury	65	39
Venus	885	72
The Earth and Moon	1,012	100
Mars	118	152
Asteroids	....	....
Jupiter	300,860	520
Saturn	89,692	954
Uranus	12,650	1,920
Neptune	16,773	3,004

Now if we commence with the combined mass of the Asteroids and compare the masses of the planets toward the sun in succession with Jupiter and those exterior to it in succession, we find what might be called an inverse ratio existing between them, for as the planets increase in mass from the combined mass of the Asteroids up to the Earth, so they decrease from Jupiter down to Uranus, and as they decrease from the Earth down to Mercury, so they increase from Uranus outward; so the mass of the Asteroids multiplied into the mass of Jupiter approximates the product of Mars' mass into the mass of Saturn, and also approximates the mass of Venus multiplied into the mass of Neptune, and the product of the mass of the Earth multiplied into that of Uranus, and should equal that of Mercury multiplied into the mass of an exterior planet outside of Neptune.

In the following table are given the products mentioned above which are obtained from the data given by R. A. Proctor:

*Although the numerical relations developed here may be only accidental, they are interesting and, indeed, rather striking. ED.

Mars and Saturn product	10,583,656
Earth and Uranus product	12,801,800
Venus and Neptune product	14,844,105

When Mr. Asaph Hall of the Naval Observatory at Washington gave his new value to the mass of Mars resulting from the discovery of the moons of Mars, which he gave as 101.8 (the sun being 315,000,000), I substituted it, and it reduced the product of the mass of Mars into that of Saturn to 9,130,645. Seeing then that the products of these masses were quite different I thought that the distance of the planets from one another and from the sun might cause the difference; so I multiplied the distances of these pairs of planets together which were used before to get the products of masses above given. The following are the products of these pairs as to their distances. (Earth as 100):

Mars and Saturn	145,008
Earth and Uranus	192,000
Venus and Neptune	216,288

A very close relation was seen here between the products of the masses of each pair and the products of their distances, for they were nearly proportional, for 145,008 : 192,000 :: 9,130,645 : 12,090,000. The amount obtained as a fourth proportional from the first three is 12,090,000, which varies from the number 12,801,800 obtained by the product of the masses of the earth and Uranus by only 1/18.

Now, if we compare the product of the masses of the Earth and Uranus with that of Venus and Neptune in the same way, making them proportional to one another as the products of their distances are proportional, we have this proportion:

192,000 : 216,288 :: 12,801,800 : 14,421,227.

The first three numbers give 14,421,227 as a fourth proportional, which varies from the number 14,844,105 obtained by the product of the masses of Venus and Neptune by only 1/35, which is certainly remarkable.

Now, if we use the product of the distances of the Earth and Uranus, comparing it with the product of the distances of the Asteroids and Jupiter, making them proportional to one another as their masses are proportional, using 265 as the mean distance of the Asteroids (The Earth being 100) and the product of this distance into that of Jupiter as 137,800, the proportion is as follows:

192,000 : 137,800 :: 12,801,800 : (the mass of the Asteroids $\times$ Jupiter's mass, which mass is 300,860).

The fourth proportional is 9,188,167 which, divided by the mass of Jupiter, gives as the combined mass of the Asteroids 30. 30 is a most reasonable estimate if we consider their probable size. All are telescopic. The largest have probably been found. The largest are probably less than 600 miles in diameter. The masses of two spheres of the same density are to one another as the cubes of their diameters. If then, the average diameter of the Asteroids is 100 miles (which is not probable) their individual mass is to that of the Earth as the cube of 100 is to the cube of the diameter of the Earth—7918. Roughly we will call it 8000. The cube of 100 is 1,000,000 and the cube of 8000 is 512 billion. So it would require 512,000 Asteroids to equal this amount if they were of the same density, and 100 miles in diameter, and it would require 15,360 Asteroids 100 miles in diameter to equal the mass of 30 which the above proportion gives as their combined mass; and less than 100 miles in diameter, say 20 miles, it would require more than 1,000,000. Hence the mass 30 would seem to be sufficient to

account for all possible conditions, whether there be millions of a very small diameter or a ring of matter not yet gathered into bodies.

The mass of the Asteroids thus seems to conform to the same relation and law to which the other planetary masses conform, and if all the known masses of the planets conform to such a law, then if there be other planets we would expect their masses to conform also. So then, we will attempt to find the mass of a Transneptunean planet by taking the product of the distances of the Earth and Uranus and making it proportional to the product of the distances of Mercury and the Transneptunean planet as the products of the masses of the Earth and Uranus are proportional to the product of the masses of Mercury and the Transneptunean planet.

The distance of the supposed Transneptunean planet we will assume to be somewhat less than twice the distance of Neptune from the Sun, so as to be in harmony with the distances of the other planets, or as 5000—that of the Earth being 100. The proportion then is 192.000 : 195,000 :: 12,801,800 : 15,602,193. By dividing this fourth proportional by 65 (the mass of Mercury) we obtain 200,028 as the mass of the Transneptunean planet, which would be a body large enough to be seen readily if in the form of one body only. The supposition then is that if there be such a body or mass, that it is in the form of a ring of matter or many small bodies like the Asteroids.

Whether there be another planet outside of Neptune or not, the planetary masses and distances as previously used present this law of relationship, to-wit:

That there is a point between the Asteroids and Jupiter from which, if we compare the planets in their order of distance on the one side with those on the other side in the order of their distance, they will decrease in mass on the one side as they increase in mass on the other side, but we find that this relationship is dependent on the distances of the planets from the Sun; that they are larger when farther from the Sun and smaller when nearer the Sun, so that the product of the masses of the two planets in the same relative position to this line of separation between the interior and exterior planets is in proportion to the product of the distances of these two planets from the Sun.

The following is a table of these products of masses and distances, including the Asteroids and a supposed outside planet or ring of matter:

	Product of Masses	Product of Distances
Asteroids and Jupiter	9,188,167	137,800
Mars and Saturn	9,130,645	145,008
Earth and Uranus	12,801,800	192,000
Venus and Neptune	14,844,105	216,288
Mercury and outside planet	13,001,828	195,000

A Second Law.

I now wish to present a second law regarding the distribution of matter in the Solar System using the family of the inner planets consisting of Mercury, Venus, Earth, Mars, and the Asteroids and comparing them with the family of outer planets consisting of Jupiter, Saturn, Uranus, Neptune and the possible Transneptunean planet.

This is the law. The combined mass of matter forming all the inner planets (Mercury, Venus, Earth, Mars, and the Asteroids) is to the combined mass of matter forming all the outer planets (Jupiter, Saturn, Uranus, Neptune, and the Transneptunean planet) as the area occupied by the family of inner planets is to the area occupied by the family of outer planets. In other words, if the combined

mass of the interior planets from Mercury to the Asteroids were spread out upon the area enclosed by a circle between Jupiter and the Asteroids and reaching to the Sun, the matter in that area would be just as dense as the matter of the combined mass of the exterior planets would make if that mass were spread out upon the area reaching out from the circle between the Asteroids and Jupiter to the limits used by the planetary forces, which limit we may well place at 6000,—the Earth's distance being 100 and the Transneptunean planet being placed at 5000 and the circle of demarkation between Jupiter and the Asteroids being 350. Circular areas are to one another as the squares of their radii.

The inner area is as the square of 350 and the outer area is as the square of 6000 less the area of the inner. The square of 350 is 122,500. The square of 6000 is 36.000,000, less 122,500, which is 35,877,500.

The masses of each family are as follows:

For the inner family, 2110 including the Asteroids as 30.

For the outer family, 620003 including the Transneptunean planet as 200023. So the proportion of mass to area would be as follows:

$$2110 : 122{,}500 :: 620{,}003 : 35{,}877{,}500.$$

The fourth proportional deduced from the first three is 35,995,435 which is only 1/304 larger than that given for the area used by the outside family. This is remarkable, as astronomers differ in their estimates of planetary masses much more than this.

So we may say that the law holds good that were the matter of each family of planets spread upon the areas they occupy it would be of the same density in the plane of each area, each having the same thickness.

A similar law may be stated in a much simpler form as follows:

The mass of matter in the family of the inner planets and the mass of matter in the family of the outer planets are proportional to the areas of the circles encompassing them, the Sun being the center in both cases, which put proportionally is as follows:

$2110 : 620{,}003 :: (350)^2 : (6000)^2$, or:

$2110 : 620{,}003 :: 122{,}500 : 36{,}000{,}000$, or:

$1 : 293.8 :: 1 : 293.8$, which is as perfect a proportion as one could expect.

H. C. Lane.

GENERAL NOTES.

Dr. R. G. Aitken, Associate Director of the Lick Observatory, delivered an address before the East Bay Astronomical Association at the Chabot Observatory on October 5. Dr. Aitken took as his topic "A Total Eclipse of the Sun."

Dr. John A. Miller, of Swarthmore College, addressed a meeting of The Franklin Institute on October 16, his subject being the information obtained from the observations made at recent eclipses.

Anthony Fiala, explorer, Commanding Officer of the Ziegler Polar Expedition, gave an address on "Our Friendly Stars of the Polar Night" on Wednesday, October 2, 1929, at The American Museum of Natural History, New York City, under the auspices of The Amateur Astronomers Association.

"The Astronomy of the Mayas" was the subject of an address by Dr. Herbert J. Spinden, under the same auspices on October 16.

Ernest Clare Bower, Assistant Professor of Astronomy and Mathematics at Ohio Wesleyan University, has been appointed Martin Kellogg Fellow in the Lick Observatory of the University of California with academic residence at the Berkeley Astronomical Department.

Dr. Dinsmore Alter of the University of Kansas is devoting a year's leave of absence to study in London as a fellow on the John Simon Guggenheim Foundation. Dr. Alter is carrying on some researches on British rainfall and in theoretical statistics.

Dr. J. A. Miller, professor of Mathematics and Astronomy at Swarthmore College, has tendered his resignation and it has been accepted by the Board of Managers. Professor Miller has been appointed Research Professor of Astronomy at Swarthmore College and Director of Sproul Observatory. He will devote his entire time to astronomical research.

The Staff of Detroit Observatory of the University of Michigan has been fortunate during the past summer in having associated with them in study, instruction, and research a number of astronomers from other institutions. Those who spent some time in Ann Arbor were: Dr. Theodore Dunham of Mt. Wilson Observatory, Mr. C. T. Elvey of Yerkes Observatory, Dr. Alice H. Farnsworth of Mount Holyoke College, Professor H. S. Harp of Wittenberg College, Dr. Alberta M. Hawes of Vassar College, Mr. Roy Marshall, Ohio Wesleyan University, Dr. E. A. Milne of Oxford University, England, Mr. N. L. Pierce of Doane College, Dr. H. H. Plaskett of Harvard College Observatory, Mr. R. M. Petrie of British Columbia University, and Mr. W. J. Williams of Baylor University. The lectures and discussions conducted by Dr. Milne were especially profitable.

Newton's Library.—Because of the importance of Sir Isaac Newton's contributions to the development of science, the fact that a substantial part of his private library has recently been brought to light has more than ordinary interest. The *Daily Science News Bulletin* for August 8, 1929, gives briefly the circumstances leading to this discovery. *The Observatory* for September, 1929, page 283, contains the following comments concerning it.

"The story of the 'find' forms one of the romances of bookselling. The existence of Newton's library was quite unknown until recent times. In 1920 a sale of furniture took place in a country house, which contained about thirty lots of books, some of which were described 'with the autograph of Isaac Newton.' Some of these books came into the possession of Messrs. Sotheran, and were catalogued as such in their science catalogues. Quite recently the owner of these books discovered a number of other volumes that had formed part of this library, and on examination they were found to constitute the larger and more important [part] of Newton's library, and these books are now offered for sale *en bloc*.

"The collection consists altogether of 858 volumes, nearly all in contemporary binding. Eighty-three of the books show actual marks of Newton's handwriting, and 20 have his autograph signature. Four of these are of special interest, as they bear the date of 1661, the year in which Newton entered Trinity College, Cambridge. The most important items of the collection are the first and second editions of the 'Principia,' full of corrections, cancellations, and additions, all in Newton's handwriting. There is also the corrected copy of the first edition of the 'Optiks,' 1704, with an important note by Newton on the limits of telescopic per-

formance. There are also a large number of books and tracts on mathematics, navigation, and political economy, and altogether the collection is one of remarkable scientific interest."

Zodiacal Light Observations.

For the first time this season local weather conditions were favorable for an observation of the morning Zodiacal Light on October 15 at 4:30 A.M. At that time the Light was clear and strong along the ecliptic from the horizon to the apex, a few degrees east of Praesepe. The main body of the Light was north of the ecliptic. Estimated breadth of the Light along the horizon was 25 degrees. The morning Zodiacal Light is not as yellowish in tint as the evening light, due perhaps to the rotation of the earth; in the morning the earth is moving towards the sun, in the evening away from it.

Moon Anthelion: While not a Zodiacal Light phenomenon, the writer desires to record the following experience: While walking in a field at 8:00 P.M., October 13, the moon being in Capricornus, eleven days old, gibbous and about 35° above the horizon on a vertical circle, the writer noticed a *bright glow surrounding the shadow of his head.* The sky was cloudless and a heavy dew was on the field. The apparition was similar in character to the anthelion. Hence the writer designates it a moon anthelion. While pondering over the experience, it has occurred to the writer that the idea of a nimbus or "glory" as used in religious art may have been suggested by the anthelion—not that he plumes himself on being entitled to any such decoration!

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BOOK REVIEWS.

The Nautical Almanac, or, to give the complete title, The Nautical Almanac and Astronomical Ephemeris, for 1931 has recently been distributed. One notes at once the increase in size in this publication. The pages are larger in both dimensions than those in the edition for 1930, and there are two hundred and ten more of them. In the preface mention is made of twenty-two respects in which this volume differs from previous volumes. It is quite evident that very careful thought has been given to the material to be included and the arrangement of it. The credit for the enlargement and re-arrangement of this issue is assigned by the Superintendent, P. H. Cowell, to the Deputy Superintendent, Dr. L. J. Comrie. Dr. Comrie made extensive use of calculating machines in the numerous and extended computations. The Nautical Almanac is published under the direction of His Majesty's Nautical Almanac Office, Royal Naval College, Greenwich, London, S. E. 10.

Tables for the Transformation of Equatorial into Galactic Coordinates, by Professor Pio Emanuelli. (Tavole per la trasformazione delle coordinate equatoriali in coördinate galattiche. Roma, Tipografia Vaticana. L. 12. XIX + 107 pp.)

All who have occasion to work with galactic problems will find these new tables by Dr. Emanuelli indispensable. While numerous other tables have been published in the past enabling one to transform equatorial into galactic coördinates, these have all used arguments at such large intervals in α and δ that extended and inconvenient interpolation was necessary. These new tables of Emanuelli

are far and away the most extensive and convenient yet published. The tabulation is for intervals of 10^m in right ascension and 1° in declination; north and south declinations are given in separate tables, and the entire celestial sphere is covered.

Convenient small tables are given at the bottom of each page for the variation in Δl and Δb in 1^m of right ascension, so that nearly all interpolations can be performed mentally. Auxiliary tables give to smaller arguments the rapidly changing galactic longitudes in the immediate vicinity of the north and south galactic poles.

A full bibliography of the subject is given in the Introduction, as well as the methods used in calculating the tables. The coördinates are referred to Newcomb's position of the galactic pole, $\alpha = 12^h\,44^m$, $\delta = +26°.8$. The zero of galactic longitudes is so chosen as to make the longitude of the apex of the sun's motion zero. H. D. C.

Publications Received.—The publishers of POPULAR ASTRONOMY hereby acknowledge the receipt of the following named publications and express their great appreciation of the courtesy shown on the part of those who have sent them.

1. Photovisual Magnitudes of Southern Stars, with Revised Values for Northern Stars, by Edward S. King. (*H.A.*, **85**, No. 10.)
2. Die Neubearbeitung der Syzygientafeln von Oppolzer, by C. Schoch. (Rechen-Institut, Berlin-Dahlem.)
3. Mathematical Tables, by L. J. Comrie. (Repr. B.A.A. Handbook for 1929.)
4. The Nautical Almanac (Abridged) 1930. (Royal Naval College, London.)
5. Katalog und Ephemeriden Veränderlicher Sterne für 1929. R. Prager. (Publ. of the Berlin-Babelsberg Observatory, No. 5.)
6. Sproul Observatory Publications No. 10. Part I. Parallaxes of Fifty Stars determined at the Sproul Observatory; Part II. Parallax of the Pleiades, by John H. Pitman.
7. The Fireballs of 1927 August 10 and October 16, by Willard J. Fisher. (Harvard Reprint 50.)
8. Studies of the Galactic Center. III. The Absolute Magnitudes of Long Period Variables, by Harlow Shapley. (Harvard Reprint 53.)
9. The Absolute Magnitudes of Long Period Variable Stars, by B. P. Gerasimovič. (Harvard Reprint 54.)
10. Lick Observatory Bulletin, No. 408. On the Disintegration of Comets, by N. T. Bobrovnikoff.
11. Lick Observatory Bulletin, No. 409. Investigation of the Orbit, Mass, and Parallax of 99 Herculis, by Maud W. Makemson.
12. Publications of the Allegheny Observatory, Vol. VI, No. 10. Magnesium Triplets in Arc and Solar Spectra, by Mary E. Warga.
13. Harvard College Observatory Circular 335. Line Intensities in Nebular Spectra, by H. H. Plaskett.
14. The Presence of Predicted Iron Lines in the Solar Spectrum and the Terms in the Arc Spectrum of Iron, by Charlotte E. Moore and Henry Norris Russell. (Mt. Wilson Contributions, No. 365.)
15. An Optical Oscillograph, by Sinclair Smith. (Mt. Wilson Contributions, No. 366.)
16. On the Variation of the Radial Velocity of TU Cassiopeiae, by Roscoe F. Sanford. (Mt. Wilson Contributions, No. 367.)
17. Temperature Classification of the Stronger Lines of Cerium and Praseodym-

ium, by Arthur S. King. (Mt. Wilson Contributions, No. 368.)

18. Stellar Radiation Measurements, by Edison Pettit and Seth B. Nicholson. (Mt. Wilson Contributions, No. 369.)
19. Evidence of Boron in the Sun, by Seth B. Nicholson and Nicolas Perrakis. (Mt. Wilson Contributions, No. 370.)
20. Photographic Observations of Some Double Stars, by Thomas H. Osgood. (Mt. Wilson Contributions, No. 371.)
21. The Spectrum and Radial Velocity Variation of RU Camelopardalis, by Roscoe F. Sanford. (Mt. Wilson Contributions, No. 372.)
22. Conference on the Michelson-Morley Experiment, held at Mount Wilson Observatory, Pasadena, California. (Mt. Wilson Contributions, No. 373.)
23. Annual Report of the Director of the Mount Wilson Observatory. (1927-28.)
24. Researches on the Structure of the Universe, by A. Pannekoek. (Publications of the Astronomical Institute of the University of Amsterdam.)
25. On the Distribution of the Apparent Magnitudes of the Foreground Stars of Dark Nebulae, by W. Gyllenberg. (Meddelande Fran Lunds Astronomiska Observatorium.)
26. The Moving Foreground of the Large Magellanic Cloud, by William J. Luyten. (Harvard College Observatory Circular No. 328.)
27. The Photometry of Unstandardized Slit Spectra, by Frank S. Hogg. (Harvard College Observatory Circular No. 337.)
28. Eighty-third Annual Report of the Director of The Astronomical Observatory of Harvard College, for the year ending September 30, 1928, by Harlow Shapley.
29. Orbita definitiva della cometa 1913-II (Schaumasse), by Francesco Zagar. (R. Osservatorio Astronomico di Padova.)
30. Osservazioni e Memorie, by R. Osservatorio Astrofisico di Arcetri. (Pubblicazioni della R. Universita Degli Studi di Firenze.)
31. Traiettorie Piane nel Problema Dei Tre Corpi, by Francesco Zagar. (R. Osservatorio Astronomico di Padova.)
32. The Castor System, by D. A. Barlow. (Publications of the Dominion Observatory, Ottawa.)
33. Determinazioni di Gravità Relativa, by Giovanni Silva. (R. Osservatorio Astronomico di Padova.)
34. A Photometric Study of the Continuous Spectra of Giant and Dwarf Stars, by Norman Wyman Storer. (Lick Observatory Bulletin, No. 410.)
35. Elements and Ephemeris of Minor Planet Y.O.6. (1922 MY), by C. J. Krieger and D. C. Duncan. (Lick Observatory Bulletin, No. 411.)
36. The Radial Velocity Curve of the Cepheid Variable κ Pavonis, by T. S. Jacobsen. (Lick Observatory Bulletin, No. 412.)
37. Catalogue de 419 Étoiles de Comparison pour la Planète Eros, by F. Moreau, G. Becq, L. De Clerck and J. Verbaandert. (Annales de L'Observatoire Royal de Belgique.)
38. Annuaire de L'Observatoire Royal de Belgique, for the year 1930.
39. Publications de Laboratoire D'Astronomie et de Géodésie. (L'Université de Louvain.)
40. Katalog und Ephemeriden Veränderlicher Sterne für 1927, by R. Prager. (Kleinere Veröffentlichungen der Universitätssternwarte zu Berlin-Babelsberg.)
41. Memoirs of the British Astronomical Association, Vol. XXVIII. Tenth Report of the Section for the Observation of Variable Stars.